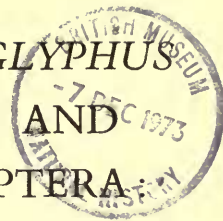


A REVISION OF THE GENERA *HIEROGLYPHUS*
KRAUSS, *PARAHIEROGLYPHUS* CARL AND
HIEROGLYPHODES UVAROV (ORTHOPTERA
ACRIDOIDEA)



BY
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By JOYCE B. MASON

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SYNOPSIS

The genera *Hieroglyphus* Krauss, *Parahieroglyphus* Carl and *Hieroglyphodes* Uvarov are revised and keys are given to their species. All the genera and previously known species are redescribed. One generic and two varietal names are newly synonymized and one new species is described. Eleven lectotypes and one neotype are designated for the group.

INTRODUCTION

THE group Hieroglyphi was first mentioned by I. Bolívar (1912) for a heterogeneous assemblage of mainly unrelated genera which included *Bermiodes* Bolívar, *Hieroglyphus* Krauss and *Hieroceryx* Bolívar (= *Parahieroglyphus* Carl). Later this group-name was restricted by Uvarov (1922) to the genera *Hieroglyphus*, *Parahieroglyphus* and *Hieroglyphodes*, and he subsequently (1932) added *Miramia* Uvarov (here synonymized with *Hieroglyphus*). Analysis of the genera has revealed

that they are not closely related; all that united them was their superficial similarity, especially the black pattern and coloration. The phallic complex, which exhibits the most essential characters, is completely different and characteristic for each genus. The species have not been well defined and very few illustrations of them have been given. The present revision of the group of genera was undertaken in order to sort out the confusion of species and genera which has arisen, and particularly to utilize the characters of the phallic complex (Dirsh, 1956) for this purpose. The genera are important from the economic point of view, as many of the species are major pests of rice, sugar-cane and other crops in Africa, India and the whole of South-East Asia. Information on their biology and economic importance is therefore included in brief.

ACKNOWLEDGEMENTS

Most of the material used in this revision was that of the British Museum (Natural History) (BMNH). Other material, including types, was made available by the following museums and institutions:

Academy of Natural Sciences of Philadelphia (ANS); Anti-Locust Research Centre, London (ALRC); Department of Agriculture, Bangkok, Bangkok, Thailand (DAB); Instituto Español de Entomología, Madrid (IEE); Muséum d'Histoire Naturelle, Geneva (MHN); Museum für Naturkunde der Humboldt-Universität, Berlin (MNHU); Muséum National d'Histoire Naturelle, Paris (MNHN); Naturhistorisches Museum, Vienna (NM); Naturhistoriska Riksmuseum, Stockholm (NR); Natuurhistorisch Museum, Maastricht, Netherlands (NMM), Universitetets Zoologiske Museum, Copenhagen, (UZM); US National Museum, Washington, DC (USNM); Coll. Dr F. Willemse, Laurastraat 67, Eindhoven, Netherlands (WEN).

The abbreviations given in parentheses are used for the type-depositories cited in this work, indicated with the synonymy.

I wish to thank Dr T. H. C. Taylor and Dr D. R. Ragge for reading and editing this manuscript.

THE PHALLIC COMPLEX

Dissection of the internal genitalia revealed most important characters within the genera. The epiphallus of *Hieroglyphodes* and *Parahieroglyphus* is divided (Text-figs 115, 125, 134, 142), while that of *Hieroglyphus* is not divided (Text-figs 12, 23, 36, 44, 52, 63, 74, 85, 94, 102). This seems to suggest that the two former genera are from a different evolutionary line to *Hieroglyphus* and that convergent evolution has occurred in the external characters. From the external features, however, *Hieroglyphodes* is more similar to *Hieroglyphus* than to *Parahieroglyphus*. We may therefore conclude that the group Hieroglyphi is a heterogeneous assemblage, based solely on external similarity. On the basis of the phallic complex *Hieroglyphus*, *Parahieroglyphus* and *Hieroglyphodes* are not related so closely as previous authors have suggested.

The endophallus was found to be very difficult to dissect, as in some cases the apical and basal valves of the penis appeared to be connected by a very thin flexure-like structure, but not the usual flexure found in other Acrididae. As the thread-like connection was so thin it was difficult to decide, even under the highest magnification used ($\times 100$), whether the valves were connected or not. Many specimens were dissected in each species and no definite conclusion was reached. The penis valves were therefore dissected longitudinally in every species and examined from the inner side. In the majority of cases the valves appeared to be separate, and have been so drawn. However, in *Hieroglyphus concolor* (Walker) the large type-specimen was dissected, and the valves appeared to be connected; I have illustrated this by dotted lines in the figure (Text-fig. 35). The problem of whether a flexure exists or not can only be solved when the whole subfamily Hemiacridinae is revised. All genitalia were originally drawn under a magnification of $\times 100$.

It must be stressed that in some Hemiacridinae, particularly in some Madagascan genera, there is a tendency to form a weak to well developed flexure (Dirsh & Descamps, 1968).

THE FEMALE SUBGENITAL PLATE AND OVIPOSITOR VALVES

It was found that most of the species differ in the structure of the female subgenital plate and the ventral ovipositor valves. In some species the subgenital plates are trilobate and the lateral lobes are of different size and shape from the median one; some have a median lobe only. The plate may possess parallel ridges with or without spines. In each case the plate was removed and slightly flattened before the external characters were drawn. These characters, especially in combination with the lower part of the ovipositor valves, can be used to identify the females.

The ventral side of the lower ovipositor valves differs in the genera and species. Sometimes they are thin and elongated but they may be shorter and stouter; in some species a well developed ridge is present across the valves, and in others the teeth on the valves are elongate and sharp, or they may be rounded.

HISTORY OF THE GENERA

The genus *Hieroglyphus* was first described by Krauss in 1877 for the species *H. daganenis* and the variety *H. daganensis* var. *abbreviata*. Kirby (1910) recorded four species in his catalogue. Bolívar (1912) described the group Hieroglyphi, but this included other unrelated genera besides those which were considered later to belong to this group; the genus *Hieroglyphus* was redescribed, three new species were added and seven were included in the key. Carl (1916) redescribed the genus again and added three new species. Uvarov (1922) published a review of *Hieroglyphus* and its nearest allies. He disregarded some of the genera that Bolívar had previously included but added to the group Hieroglyphi the genera *Parahieroglyphus* and *Hieroglyphodes*; he also redescribed *Hieroglyphus* (and all its species), synonymized some species, and described one new one and a variety. His key contained eight species.

The genus *Parahieroglyphus* was described by Carl in 1916 for the species *P. bilineatus*, and he associated it with *Hieroglyphus*. In 1922 Uvarov redescribed the genus and added the species *P. colemani*.

The genus *Hieroglyphodes* was described by Uvarov in 1922 for the species *H. assamensis*. In 1961 Roy added a second species, *H. occidentalis*.

KEY TO THE GENERA

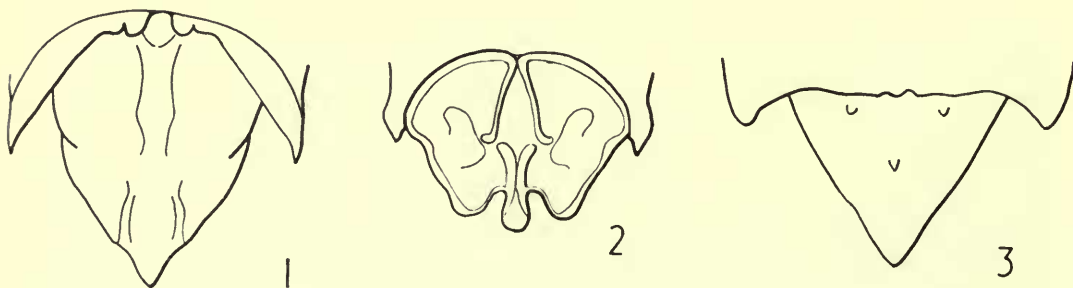
- 1 Male supra-anal plate narrower than long, with sides excurved towards apex (Text-fig. 1). Male cercus of medium size, simple, slightly curved and gradually narrowing to apex, bifurcate, or bilobate (Text-figs 18, 98, 80) **HIEROGLYPHUS** Krauss (p. 512)
- Male supra-anal plate broader than long, with straight sides narrowing to acute-angular apex or trilobate at apex, with very small middle lobe (Text-figs 3, 2). Male cercus large, upcurved at base and with expanded apex, or trilobate (Text-figs 110, 128) 2
- 2 (1) Pronotum with shallow sulci. Male supra-anal plate with straight sides, narrowing to acute-angular apex (Text-fig. 3). Male cercus very large, trilobate, with very large expanded middle lobe (Text-figs 110, 121). **PARAHIEROGLYPHUS** Carl (p. 547)
- Pronotum with deep sulci. Male supra-anal plate trilobate with small middle lobe (Text-fig. 2). Male cercus large, upcurved at base and with expanded apex (Text-figs 128, 138) **HIEROGLYPHODES** Uvarov (p. 552)

HIEROGLYPHUS Krauss, 1877

Hieroglyphus Krauss, 1877 : 41. Type-species, by monotypy, *Hieroglyphus daganensis* Krauss, 1877.

Miramia Uvarov, 1932 : 224. Type-species, by monotypy, *Miramia perpolita* Uvarov, 1932. **Syn. n.**

Medium to large size. Comparatively slender to robust. Integument coarsely or finely pitted. Sparsely or densely hairy on ventral surface. Antenna filiform, longer than head and pronotum together, with 27-30 segments. Fastigium of vertex with slight depression in front of a bow-shaped transverse furrow, broader than long, with an obtuse-angular apex; weak carinula of vertex present or absent; frontal ridge with moderately deep or shallow sulcus, parallel-sided or widening towards base and narrowing towards apex. Pronotum



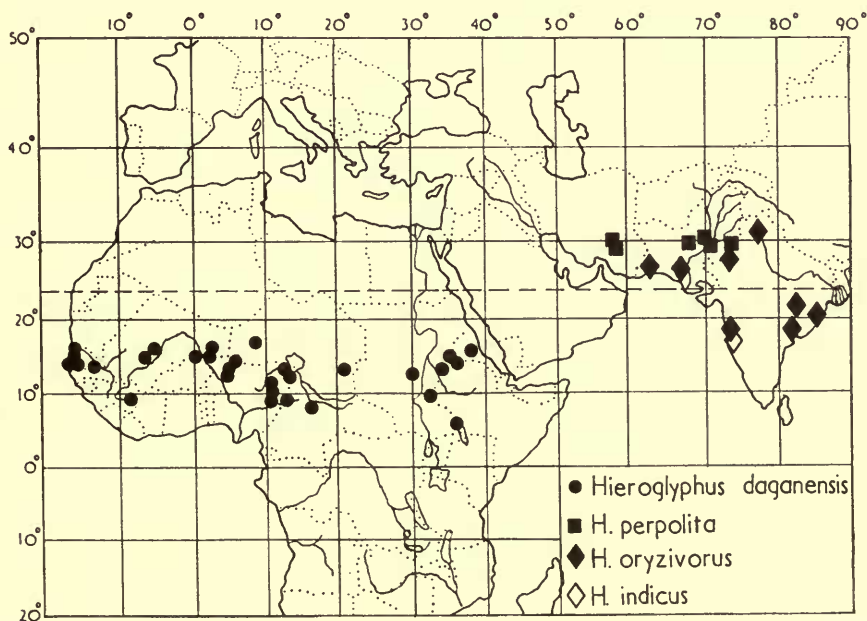
FIGS 1-3. Male supra-anal plate. 1, *Hieroglyphus banian* (F.); 2, *Hieroglyphodes occidentalis* Roy; 3, *Parahieroglyphus bilineatus* (I. Bolívar).

cylindrical; median carina weak, linear or obliterated behind first sulcus or in metazona; three or four broad or narrow sulci present; lateral carinae absent; metazona shorter than prozona; its posterior margin obtuse-angular or rounded. Prosternal process conical or bifurcate. Tegmina and wings fully developed or shortened. Radial area of tegmen with several regular thickened, transverse, stridulatory veinlets, moderately developed (except in micropterous species). Tubercles present on anterior margin of tegmen and in the precostal, costal and subcostal area (the function of these tubercles is unknown). Hind femur slender to moderately robust. External apical spine of hind tibia present. Arolium moderately large. Supra-anal plate longer than its width, narrowing towards apex, apex elongate subacute; elongate ridges present with shallow median sulcus. Cercus simple or bifurcate with subacute pointed or obtuse apex. Subgenital plate elongate with subacute or emarginate apex.

Phallic complex. Apical and basal valves of penis divided or with tendency to form a very thin connection between the valves. Basal valves of penis moderately robust to robust. Ectophallic membrane with ventral sclerotization. Epiphallus large, bridge-shaped, not divided, with small to moderately large ancorae and small or large lophi.

Ovipositor slender to moderately robust with curved valves; lower valve with two teeth well or poorly defined. Female subgenital plate with median lobe only or trilobate with medium lobe longer than the lateral lobes.

The genus *Miramia* was described by Uvarov as being related to *Hieroglyphus*. He separated the genus on the following characters, 'the frontal ridge with the sides straight, gradually divergent downwards, sulcate throughout. Lateral margins of fastigium of vertex thick convex. Pronotum without any trace of median keel. Prosternal spine straight, transverse in section, with the apex bituberculate. Male cerci simple. Female subgenital plate trilobate apically.' However, now that more material is available for study from Pakistan, I have found that the pronotum has a weak median carina and the female subgenital plate is trilobate in other



MAP 1. Distribution of *Hieroglyphus daganensis*, *H. perpolita*, *H. oryzivorus* and *H. indicus*.

species of *Hieroglyphus*; these characters therefore cannot be considered as generic. The frontal ridge is variable and the other characters are unimportant and of no generic value. Dissection of the phallic complex also verifies that *perpolita* is typical of *Hieroglyphus*, with the valves of the cingulum being much longer than the apical valves of the penis and narrowing at the apex. The simple male cercus, the presence of the two ridges on the female subgenital plate (not mentioned by Uvarov) and the fact that the lower valves of the ovipositor possess a ridge across the ventral surface (not mentioned by Uvarov) places this species into the first group of species of *Hieroglyphus*. The genus *Miramia* cannot therefore be separated as a distinct genus.

KEY TO THE SPECIES

- | | | |
|-------|---|---|
| 1 | Male cercus with apex simple (Text-figs 6, 58) | 2 |
| - | Male cercus with apex bifurcate or bilobate (Text-figs 98, 80, 88) | 8 |
| 2 (1) | First and third sulci on sides of pronotum not joined by black band (Text-figs 4, 29) or, if joined, then also with irregular stripes connecting all sulci on dorsum (Text-fig. 46). Posterior margin of pronotum obtuse-angular (Text-figs 4, 29). Male cercus straight or downcurved at apex (Text-figs 6, 30) | 3 |
| - | First and third sulci on sides of pronotum joined by black band, without irregular stripes connecting all sulci on dorsum (Text-figs 56, 68). Posterior margin of pronotum rounded (Text-figs 56, 68). Male cercus upcurved at apex (Text-figs 58, 70) | 7 |
| 3 (2) | Apex of male cercus not oblique (Text-figs 6, 18, 30) | 4 |
| - | Apex of male cercus oblique (Text-figs 40, 48) | 6 |
| 4 (3) | Pronotum with four broad black sulci crossing dorsum (Text-fig. 4). Prosternal process bituberculate (Text-fig. 8) <i>perpolita</i> Uvarov (p. 515) | |
| - | Pronotum with three sulci crossing dorsum (Text-figs 16, 29). Prosternal process conical (Text-fig. 19) | 5 |
| 5 (4) | Body moderately slender. Apex of male cercus subacute, much longer than supra-anal plate (Text-fig. 17). Female subgenital plate with two smooth ridges (Text-fig. 25) <i>annulicornis</i> Shiraki (p. 517) | |
| - | Body robust. Male cercus slightly longer than supra-anal plate (Text-fig. 31). Female with two spiny ridges on the subgenital plate (Text-fig. 37) <i>concolor</i> (Walker) (p. 521) | |
| 6 (3) | Pronotum with sides only slightly expanded in metazona; dorsum without characteristic pattern connecting all sulci by irregular stripes (Text-fig. 38). Male cercus with stout subacute apex, roundly oblique on upper margin (Text-fig. 40). Female subgenital plate with two spiny ridges (Text-fig. 45) <i>africanus</i> Uvarov (p. 524) | |
| - | Pronotum with sides markedly expanded in metazona; dorsum with characteristic black pattern connecting all sulci by two irregular stripes (Text-fig. 46). Male cercus with elongate acute apex, oblique on upper margin (Text-fig. 48). Female subgenital plate without parallel ridges (Text-fig. 54) <i>nigrorepletus</i> Bolívar (p. 526) | |
| 7 (2) | Male subgenital plate with emarginate apex (Text-fig. 57). Female subgenital plate trilobate, with relatively large lateral lobes and median lobe longer than lateral (Text-fig. 65). Epiphallus with lobiform lophi and no second lobe facing towards the centre of the bridge (Text-fig. 63). (African species) <i>daganensis</i> Krauss (p. 531) | |
| - | Male subgenital plate with truncate apex (Text-fig. 69). Female subgenital plate trilobate with very small lateral lobes and small median lobe (Text-fig.) | |

75). Epiphallus with lobiform lophi and with an extra smaller lobe facing towards the centre of the bridge (Text-fig. 74). (Indian species).

oryzivorus Carl (p. 534)

8 (1) Male cercus bilobate or shallowly bilobate (Text-figs 80, 88). Lower valves of ovipositor short and stout, the external lateral projection of lower valve rounded, and ill defined (Text-figs 86, 95). 9

— Male cercus bifurcate, relatively slender, with upper branch of fork recurved anteriorly towards head and lower branch elongate and acute (Text-fig. 98). Lower valves of ovipositor long and slender with external lateral projection well-defined and acute (Text-fig. 105) *banian* F. (p. 540)

9 (8) Micropterous (Text-fig. 81). Male cercus shallowly bilobate, relatively narrow with upper lobe shorter than lower, both lobes rounded (Text-fig. 80)

indicus sp. n. (p. 536)

— Macropterous. Male cercus bilobate, broad with upper lobe rounded or with irregular edge, and lower lobe thin, elongate, pointed at apex (Text-figs 88, 89)

tonkinensis Bolívar (p. 538)

DESCRIPTIONS OF THE SPECIES

Hieroglyphus perpolita (Uvarov, 1932) **comb. n.**

(Text-figs 4-15, Map 1)

Miramia perpolita Uvarov, 1932 : 224. Holotype ♂, IRAN: South-east, Basman to Tarab, Eastern Kerman, 9.viii.1898 (Zoological Institute, Leningrad).

♂. Large. Moderately robust. Integument shallowly pitted, shiny. Densely hairy on ventral surface of abdomen. Antenna 28-segmented. Fastigium of vertex twice as broad as long, frontal ridge widening downwards, shallowly sulcate. Pronotum cylindrical; dorsum crossed by four wide sulci; posterior margin of pronotal disc widely obtuse-angular; prosternal process bifurcate. Mesosternal interspace narrowly open; metasternal interspace closed.

Tegmina and wings extending beyond end of abdomen. Hind femur moderately robust. Supra-anal plate angular, with obtuse apex. Cercus simple, thick, longer than supra-anal plate, slightly down-curved, with subacute apex. Subgenital plate with subacute apex.

Phallic complex. Apical valves of penis narrow, shorter than valves of cingulum, narrowing at apex; valves of cingulum slightly upcurved, with subacute apex; basal valves of penis robust, slenderly expanded at end; dorsal ridge of valves smooth at basal end; gonopore process elongate, narrowing towards truncate apex; zygoma of cingulum narrow; rami broad; apodemes shorter than basal valves of penis, broad with obtuse apices. Epiphallus broader apically than basally, ancorae of medium length, turning outwards; lophi elongate, not lobe-shaped, pointed inwards, with subacute apices.

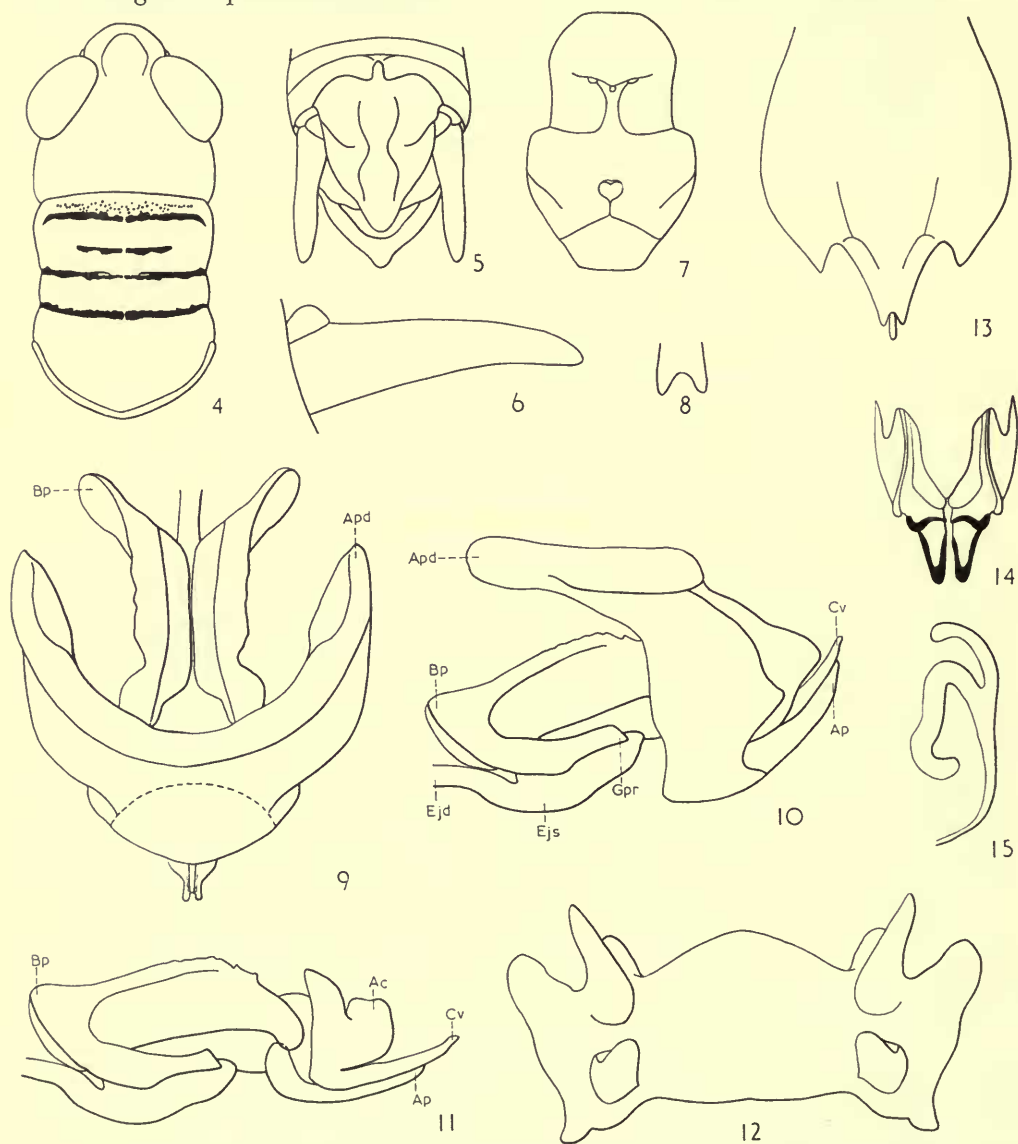
General coloration green or greenish buff, with yellowish buff patches; sulci on pronotum black; wings hyaline, veins green, grey or brownish buff; inner and lower side of hind femur orange-red; hind tibia bluish grey, with black band at base; spines buff, with black tips, base of tarsi black with bluish tinge.

♀. As the male, but much larger and more robust. Differs in the fastigium of vertex being approximately three times as broad as long; subgenital plate trilobate, with outer lobes shorter than median lobe; median lobe with two ridges converging towards apex, ridges relatively smooth with a few small spines; lower valves of ovipositor with external lateral projection forming ridge across ventral surface.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	26.6-41.2	8.2-8.4	30.4-32.1	17.4-17.5
Female	38.7-52.5	9.1-13.0	29.4-44.4	18.2-24.9

This species differs from *H. annulicornis* in that the cercus is straight, not incurved, with the apex less downcurved. There are four sulci on the pronotum. The prosternal tubercle is bifurcate, the lobes of the epiphallus are pointed, and the female subgenital plate is trilobate.



FIGS 4-15. *Hieroglyphus perpallita* (Uvarov). Male, 4, head and pronotum, from above; 5, end of abdomen, from above; 6, cercus, lateral view; 7 meso- and metasternum; 8, prosternal tubercle, front view; 9, phallic complex, from above, with epiphallus and ectophallic membrane removed; 10, same, lateral view; 11, endophallus, lateral view; 12, epiphallus. Female, 13, subgenital plate, ventral view; 14, lower valves of ovipositor, ventral view (paratype); 15, spermatheca.

MATERIAL EXAMINED

IRAN: Djiroft, Bosham, vi. 1962, 1 ♂; Basman-Tarab, Prov. Kerman, Zarudry. 9.viii.1898, 1 ♀ (paratype). PAKISTAN: Harnai, 12.viii.1931 (Y. R. Rao), 2 ♀. 1.viii. 1931, 1 ♀; nr Multan, 3.vii.1963 (G. Popov), 1 ♀; Loralai, 7.viii.1931, 1 ♀; Bahawalpur, Yazman, 7-8.vii.1963 (G. Popov), 3 ♀.

Hieroglyphus annulicornis (Shiraki, 1910)

(Text-figs 16-28, Map 2)

Oxya annulicornis Shiraki, 1910 : 57. 1 ♂, 1 ♀ syntypes, TAIWAN (lost). NEOTYPE ♂, TAIWAN: Takao, 6.viii.1907 (H. Sauter) (BMNH), here designated [examined].

Hieroglyphus formosanus I. Bolívar, 1912 : 55. Holotype ♂, TAIWAN: Ku-Sia (IEE, Madrid) [examined]. [Synonymized by Uvarov, 1922 : 234.]

Hieroglyphus tonkinensis Carl, 1916 : 479 (nec *H. tonkinensis* I. Bolívar, 1912). Holotype ♀, VIETNAM (NORTH): Than-Moi, vi-vii (H. Fruhstorfer) (MHN, Geneva) [examined]. [Synonymized by Uvarov, 1922 : 234.]

♂. Medium size. Moderately slender. Integument coarsely pitted, shiny, especially pronotum. Densely hairy on ventral surface of abdomen. Antenna 29-segmented. Fastigium of vertex twice as broad as its length; median carinula of vertex weak or absent; frontal ridge with moderately deep sulcus. Median carina of pronotum present or absent; three sulci crossing dorsum; posterior sulcus broader and deeper than other two; posterior margin of metazona, slightly wider than right angle. Prosternal process conical. Mesosternal interspace slightly open; metasternal interspace closed.

Tegmina and wings reaching end of abdomen. Hind femur slender. Supra-anal plate with small narrow apex. Cercus simple, much longer than supra-anal plate, down-curved and incurved, narrowing to subacute apex. Subgenital plate with subacute apex.

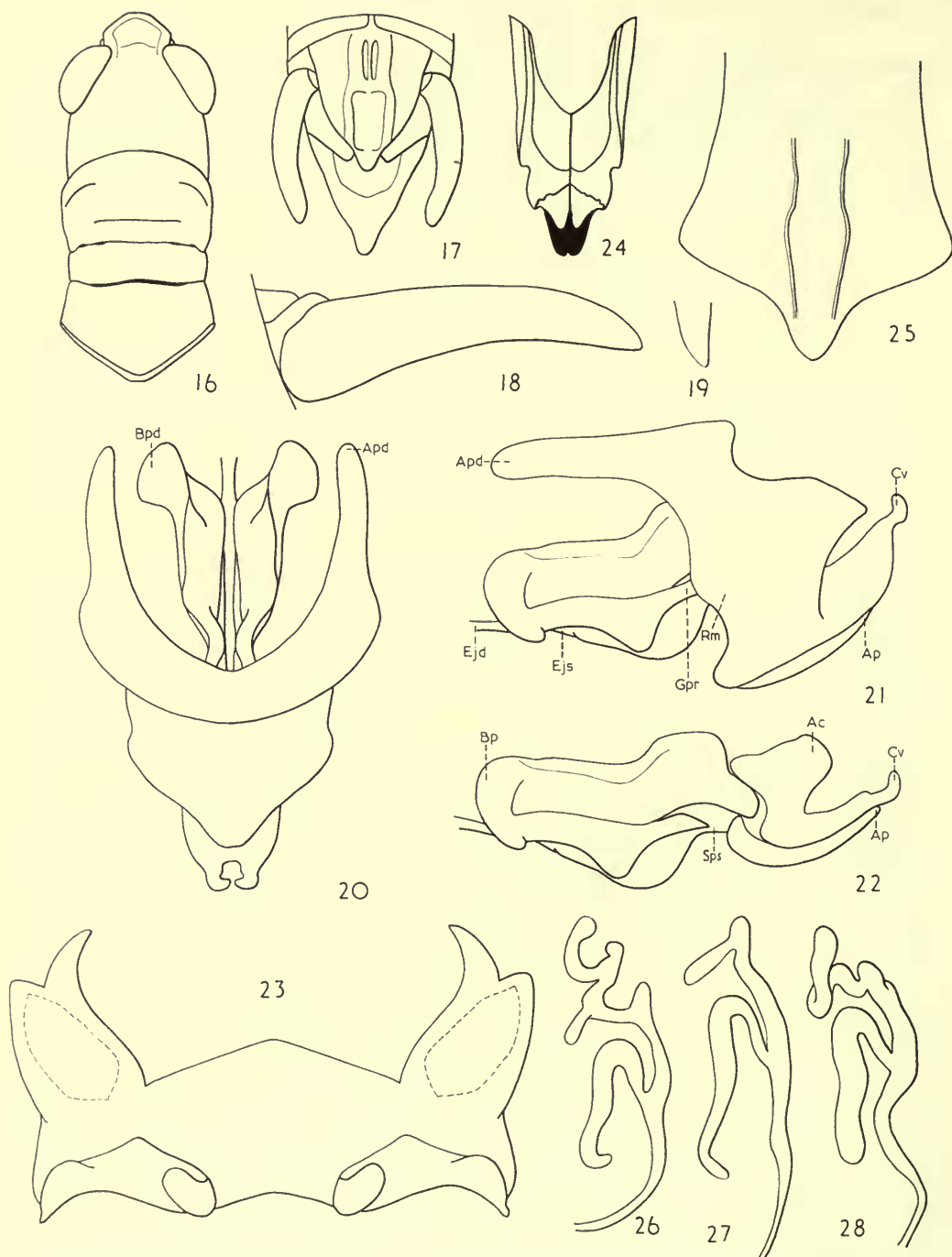
Phallic complex. Apical valves of penis much shorter than valves of cingulum, narrowing at apex; valves of cingulum narrowing, upcurved and incurved at apex; basal valves of penis moderately robust, expanded at end; dorsal ridge of valves smooth; gonopore process elongate with expansion in middle and narrowing towards apex; zygoma of cingulum moderately broad; rami broad; apodemes of cingulum approximately the same length as basal valves of penis, relatively narrow with subacute apices. Epiphallus broad near ancoras, with two regions of weaker sclerotization; lophi with inner lobe curving outwards.

General coloration green-buff or greenish buff, with yellowish brown patches; sulci on pronotum black, the posterior one broader than the others; wing hyaline, veins dark brown and pale buff; hind knee with black patch on inner side continuing on tibia; base of tibia and tips of spines black, rest of tibia pale green or buff (probably faded).

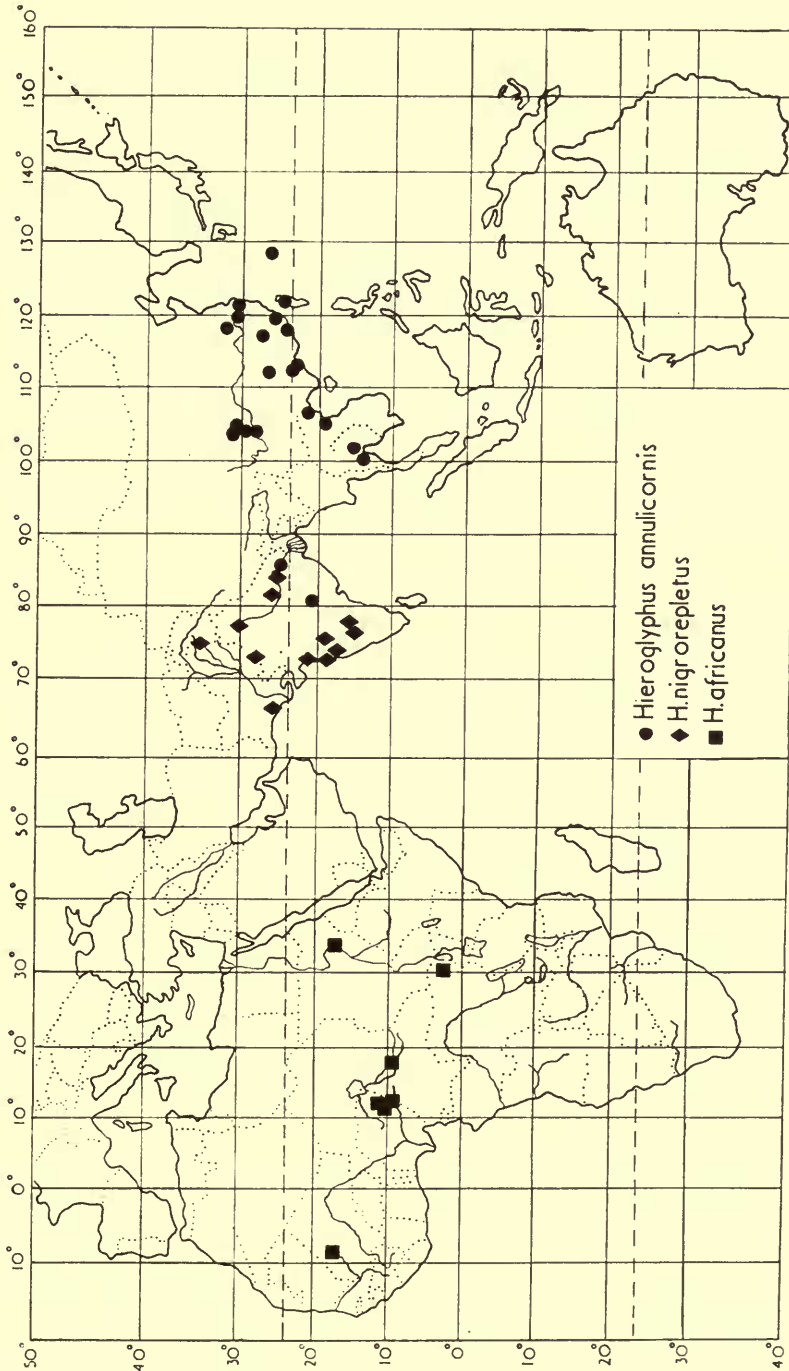
♀. As the male, but larger. Differs in that fastigium of vertex is three times as broad as long; mesosternal interspace more open than in male; subgenital plate with subacute median lobe and two smooth wavy, parallel, ridges sometimes with spines; lower valves of ovipositor with external lateral projection forming a deep ridge across ventral surface of valves; spermatheca large, apical diverticulum long, narrow, curving back at basal end, preapical diverticulum long, narrow, with one small branch curving backwards.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	33.8-45.0	7.3-9.0	26.7-33.0	18.1-21.7
Female	42.5-62.3	8.3-12.9	29.4-40.1	19.6-27.8



FIGS 16-28. *Hieroglyphus annulicornis* (Shiraki). Male, 16, Head and pronotum, from above; 17, end of abdomen, from above; 18, cercus, lateral view; 19, prosternal tubercle, lateral view; 20, phallic complex, from above, with epiphallus and ectophallic membrane removed; 21, same, lateral view; 22, endophallus, lateral view; 23, epiphallus. Female, 24, lower valves of ovipositor, ventral view; 25, subgenital plate, ventral view; 26-28, variation of spermatheca.



MAP 2. Distribution of *Hieroglyphus annulicornis*, *H. nigrorepletus* and *H. africanus*.

Shiraki (1910) attributed the name *Oxya annulicornis* to Matsumura, but the relevant description by Matsumura was published after that of Shiraki. The work of Shiraki, which has the date 1910 on the cover, gives the date 4 May 1909. Matsumura's first description is dated 28 July 1910, and the species should therefore be attributed to Shiraki. Uvarov (1922) synonymized *H. formosanus* Bolívar, 1912 and *H. tonkinensis* Carl, 1916 with *H. annulicornis* (Shiraki, 1910), and with this the present author agrees.

This species belongs to the group containing *H. perpallida*, *H. concolor*, *H. africanus* and *H. nigrorépletus*. It is most closely related to *H. concolor*, which it resembles in the simple form of the male cercus, the shape of the supra-anal plate and the long upcurved valves of cingulum. The female is a member of the group by the presence on the plate of two parallel ridges; the external lateral projection of the ovipositor valves extends to a deep ridge crossing the ventral surface. *H. annulicornis* differs from *H. concolor* in that the male cerci are much longer, and the epiphallus broader, and that in the female the two ridges on the subgenital plate are smooth and do not possess large spines.

It seems certain that all Shiraki's type-material is lost. It has therefore been impossible to trace the syntypes of *Oxya annulicornis* and so I have designated a neotype.

MATERIAL EXAMINED

CHINA: 1896 (*R. P. J. Joanini*), 1 ♂; 1893 (*R. P. J. Soames*), 2 ♀; Szechuan, Friedrich, Bebe Bez, Chunking, 1929-31, 4 ♂, 3 ♀; Suifu, 1920 (*D. C. Graham*), 1 ♀; Kuanshien, 1000'-2200' (*D. C. Graham*), 1 ♀; 1600'-2200', 27-29.viii.1934, 1 ♀; 3000', 2 ♀; Chunking, viii. 1934, 2 ♀; 1912 (*W. A. Maw*), 2 ♂; Mt Omei, Baian-Kara, Ula Range, 2500', 6.viii.1929, 1 ♀; Kwanhsien, 8.viii.1930, 1 ♂, 1 ♀; Amoy, 1 ♀; (*C. F. Wu*), 1 ♂, Nanking, 1932 (*T. L. Tsou*), 1 ♂, 1 ♀; 1933, 2 ♂, 29.vii.1924 (*N. S. Chang*), 1 ♀; Hong Kong, 1911 (*F. W. Terry*), 1 ♀; Shanghai, viii. 1935, 2 ♂, 20.viii. 1933, 1 ♂; Kaing Su, 10.x.1919 (*E. Suenson*), 1 ♀; 25-28.viii.1928 (*E. Suenson*), 3 ♂, 8 ♀; Kolthoff, 3 ♂; Chekiang, 17.viii.1933, 1 ♀; Hangtcheou, 1925 (*A. Pichon*), 2 ♀; Fukien, Foochow (*C. R. Kellog*), 2 ♂; 1923 (*C. R. Kellog*), 2 ♂; 1935 (*M. S. Yang*), 1 ♂; Soochow (*C. F. Wu*), 1 ♂; 3-11.v.1918 (*E. Suenson*), 1 ♂, 1 ♀; Kiang-Si, 1875 (*A. David*), 1 ♀; Fukien, Shaowu, 500 m, 24.viii.1937 (*J. Klapperich*), 1 ♀; Chatabon (*S. S. Flower*), 1 ♀. HONAN ISLAND: Canton, 28.vi.1933 (*W. E. Hoffmann*), 1 ♂. THAILAND: Lop Buri, 14.v.1964 (*C. Pranarnttha*), 1 ♀; Nakhon Ratchasima, 24.vi.1962 (*P. Pholboon*), 1 ♂, 2 ♀. VIETNAM (NORTH): Hanoi, 1911 (*G. Dupouy*), 1 ♀; Than-Moi, vi-vii. (*H. Fruhstorfer*), 2 ♀, 10.xii.1901, 1 ♀, 2-3000' (*H. Rolle*), 2 ♀; Bas, 1899 (*Dr Laboulbène*), 1 ♀. TAIWAN: Tzkaio, 5.vii.1907 (*H. Sauter*), 1 ♂; 14.vii.1907 (*H. Sauter*), 1 ♂, 6-10, viii.1907 (*H. Sauter*), 6 ♂, 2 ♀; Houli, Taichung, 18.viii.1967, Ching-yi Lee and Key Ming Ho, 1 ♂. JAPAN: Ryukyu Is, Ishlgaki Id, Luchu Ida, v. 1910 (*U. C. Thompson*), 1 ♂. INDIA: Pusa, Bihar, 26.vii.1916 (*Fletcher*), 1 ♂; Central Provinces, Raipur, 2 ♀.

BIONOMICS. There is one generation a year. The hoppers hatch in April or May. The females have one more instar than the males. They become adult

about the end of June. Roffey (unpublished MS) states that in Thailand, the adults occur between June and November. The dry season is spent in the egg-stage, as in *H. banian*.

ECOLOGY. In Taiwan the nymphs occur on the grass *Miscanthus* (Takahashi, 1938). Roffey (unpublished MS) states that this species appears to occupy similar habitats to those of *H. banian*: that is, areas of upland crops and the surrounding graminaceous vegetation. It feeds on the following plants:

Bambusa spp. (Takahashi, 1938)
Canna indica L. (Mishchenko, 1952)
Durio zibethinus (Roffey, unpublished MS)
Imperata cylindrica (Takahashi, 1938)
Miscanthus spp. (Takahashi, 1938)
Musa sp. (Banana) (Roffey, unpublished MS)
Oryza sativa (Takahashi, 1938; Roffey, unpublished MS)
Phragmites sp. (Takahashi, 1938)
Saccharum officinarum (Takahashi, 1938; Roffey, unpublished MS)
Zea mays (Takahashi, 1938; Roffey, unpublished MS)

ECONOMIC IMPORTANCE. This species sometimes causes serious damage to sugar-cane in southern Formosa (Takahashi, 1938). In 1938, over 80,000 hoppers per acre were recorded in the cane-fields in June. Rainfall exercised some control on the hoppers and outbreaks may be due to lack of rain in that month. Tinkham (1940) reports that the species is of considerable economic importance as it feeds on rice, sugar-cane, bamboo and grass that surrounds gardens (thus damaging garden plants). Roffey (unpublished MS) states that in Thailand there is no evidence of its being a serious pest.

Hieroglyphus concolor (Walker, 1870)

(Text-figs 29-37, Map 3)

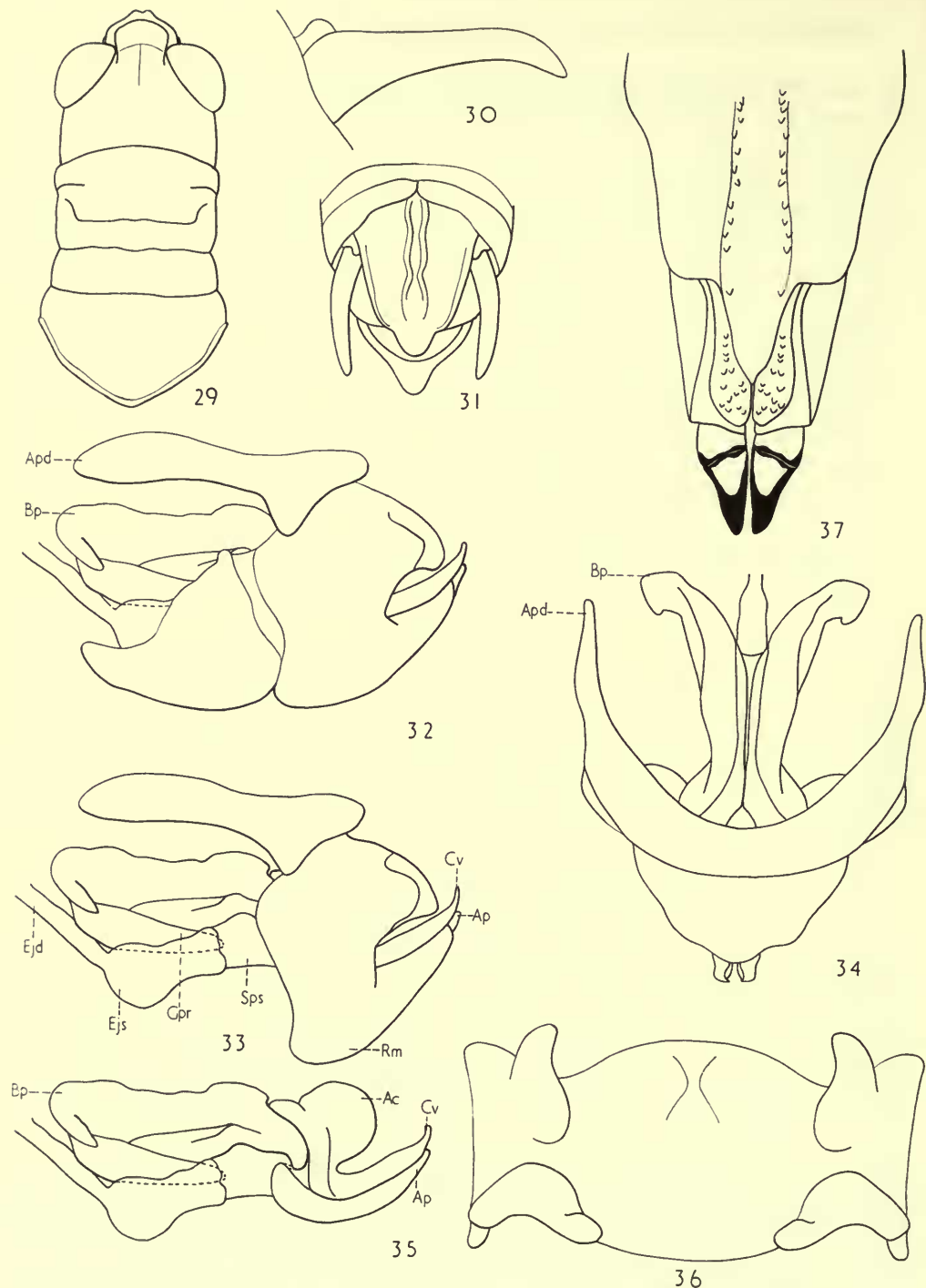
Oxya concolor Walker, 1870 : 646. LECTOTYPE ♂, N. INDIA (BMNH), here designated from 1 ♂, 1 ♀ syntypes [examined].

Hieroglyphus tarsalis Stål, 1878 : 94. LECTOTYPE ♀, INDIA: Silhet (NM, Vienna), here designated from 1 ♂, 1 ♀ syntypes [examined]. [Synonymized by Bolívar, 1912 : 54.]

Hieroglyphus citrinolimbatus Brunner von Wattenwyl, 1893 : 154. LECTOTYPE ♂, 'HIMALAYA' (NM, Vienna), here designated from 1 ♂, 1 ♀ syntypes [examined]. [Synonymized by Uvarov, 1922 : 233.]

Lectotype ♂. Large and robust. Integument moderately finely pitted. Densely hairy on distal five abdominal sternites. (Antennae broken.) Fastigium of vertex twice as broad as long; carinula of vertex weak; frontal ridge with moderately deep sulcus, slightly narrowing below ocellus. Dorsum of pronotum crossed by three sulci; posterior margin slightly more obtuse than right-angle; prosternal process conical. Mesosternal interspace three times as long as wide, open; metasternal interspace closed.

Tegmina and wings extending beyond end of abdomen. Hind femur moderately slender. Supra-anal plate narrowing towards rounded attenuate apex. Cercus simple, down-curved, slightly longer than supra-anal plate. Subgenital plate with subacute apex.



FIGS 29-37. *Hieroglyphus concolor* (Walker.) Male, 29, head and pronotum, from above; 30, cercus, lateral view; 31, end of abdomen, from above; 32, phallic complex, lateral view, with ventral sclerotization of ectophallic membrane, attached and epiphallus removed; 33, same, with ventral sclerotization of ectophallic membrane and epiphallus removed; 34, same, from above; 35, endophallus, lateral view; 36, epiphallus. Female, 37, subgenital plate and lower valves of ovipositor, ventral view.

Phallic complex. Apical valves of penis much shorter than valves of cingulum, narrowing at apex, which is upcurved and incurved; basal valves of penis moderately robust, expanded at ends; dorsal ridge of valves smooth; gonopore process elongate, narrowing to obtuse apex; zygoma of cingulum moderately broad; rami broad with upcurved projection covering apical valves of penis; apodemes of cingulum slightly shorter than basal valves of penis, narrowing at apex. Epiphallus with broad bridge, ancorae short, robust; inner lobes of lophi very elongate, curving inwards.

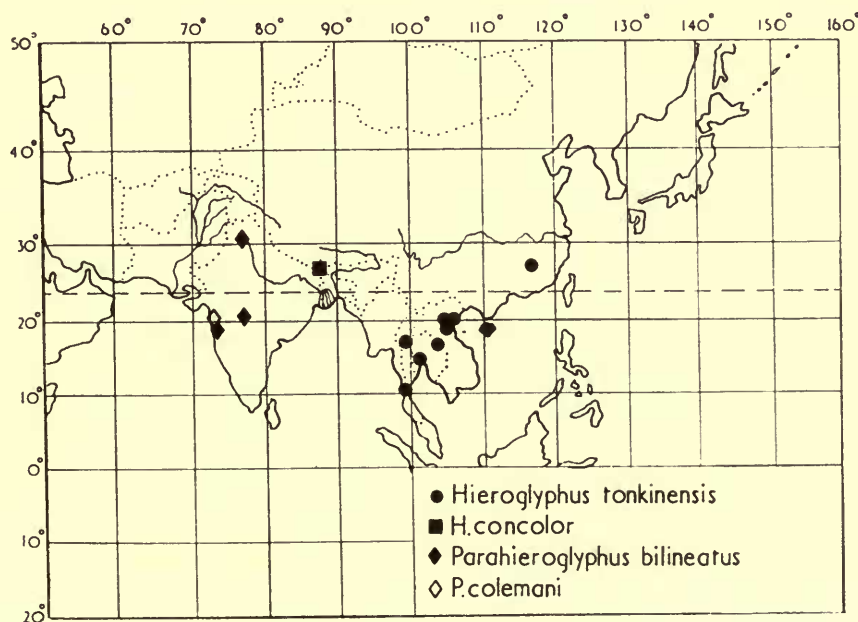
General coloration brownish buff (probably faded) with yellowish and grey patches; sulci on pronotum black, the posterior one wider than the others; wing hyaline, veins yellowish buff; hind knee with black patch on inner side continuing on tibia; base of hind tibia and tips of spines black, rest of tibia buff; basal segment of tarsi black.

♀ (paralectotype). As the male, but much larger and very robust. Differs in that the fastigium of vertex is approximately three-and-a-half times as broad as long; mesosternal interspace three-and-a-half times as long as wide; subgenital plate with subacute median lobe, and with two parallel ridges possessing large spines; lower valves of ovipositor with external lateral projection forming a deep ridge across ventral surface.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	32.5-44.8	7.7-10.6	20.8-32.8	22.4
Female	47.4-60.9	12.0-15.8	28.0-45.0	(absent)

For differentiation from *H. annulicornis* see p. 520. It is also characterized by the black coloration of the basal part of the hind tarsi. The body size is very



MAP 3. Distribution of *Hieroglyphus concolor*, *H. tonkinensis*, *Parahieroglyphus bilineatus* and *P. colemani*.

variable; Walker's types in particular are very large and robust. The coloration varies from buff to greenish yellow, the pronotum sometimes having a yellow band on its posterior margin. All types have been examined and lectotypes designated. The author agrees with the synonymy of Bolívar (1912) and Uvarov (1922).

MATERIAL EXAMINED

SIKKIM: 3 ♂, 1 ♀. 'HIMALAYA' (*H. de Saussure*) 1 ♂, 1 ♀.

Mishchenko (1952) also records it from China and Burma.

BIONOMICS. Katiyar (1960) states that there are 62–84 eggs in a pod. Gupta & Saxena (1963) give the number per pod as 123. Egg-laying occurs in Dehra Dun, India, from the third week of July to the second week of September, the maximum being during the first week of August (Katiyar, 1960). Gupta & Saxena (1963) report that in Uttar Pradesh, India, mating of this species starts in the first week of September.

The lack of data on this species may be due to the misidentification in past years, as suggested by Fletcher (1920). My study shows that it is not a common species in collections, and therefore probably not in the field.

Hieroglyphus africanus Uvarov, 1922

(Text-figs 38–45, Map 2)

Hieroglyphus africanus Uvarov, 1922 : 232. Holotype ♂, SUDAN: Atbara (BMNH) [examined].

Holotype ♂. Medium size, moderately robust. Integument coarsely pitted; densely hairy on ventral surface of abdomen. Antenna 28-segmented. Fastigium of vertex twice as broad as long; carinula of vertex absent; frontal ridge with well-developed sulcus, widened downwards. Dorsum of pronotum crossed by three broad sulci. Angle of posterior margin slightly wider than right angle. Sides of pronotum slightly excurved. Prosternal process conical. Mesosternal interspace slightly open; metasternal interspace closed. Tegmina and wings almost reaching end of abdomen. Hind femur moderately robust. Supra-anal plate with subacute apex. Cercus simple, downcurved, inner side rounded from above, narrowing to subacute apex, which is outcurved. Subgenital plate with obtuse apex.

Phallic complex. Apical valves of penis shorter than valves of cingulum, narrowing at apex, valves of cingulum expanding on dorsal side just before apex, apex upcurved and incurved; basal valves of penis slightly expanded at end; dorsal ridge of valves smooth; gonopore process elongate, narrowing to subacute apex; zygoma of cingulum moderately robust; rami broad; apodemes widely arcuate, approximately the same length as basal valves of penis, apex subacute. Epiphallus slightly broader near ancorae, narrowing towards lophi, lophi with inner lobe curving inwards.

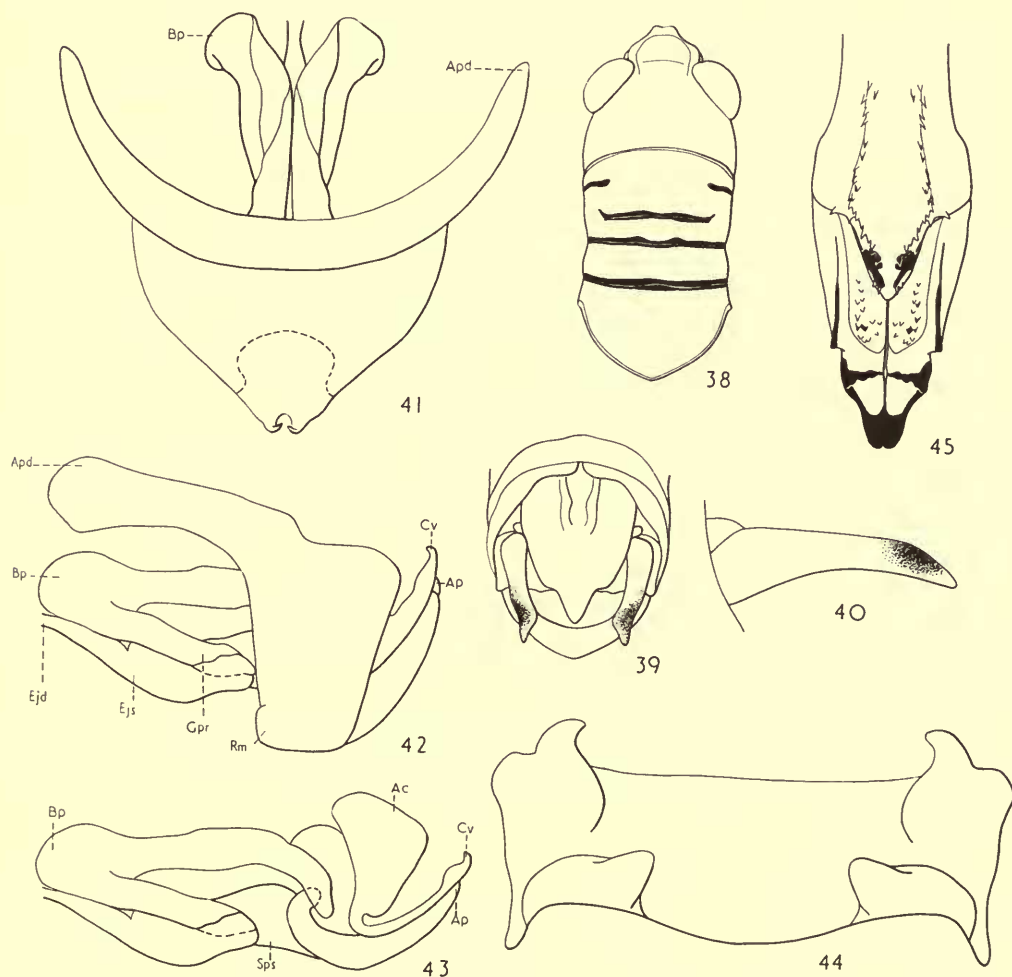
General coloration pale greenish buff with light buff patches, antennae black, pronotum with pale buff or yellowish margins, sulci black; wing hyaline, veins dark brown or greenish buff, hind knee with black patch on inner side continuing on tibia, base of tibia and tips of spines black, tibia greenish buff.

♀. As the male, but larger. Differs in the fastigium of vertex being two-and-a-half times

broader than long; mesosternal interspace slightly more open than in male; median lobe of subgenital plate with subacute apex, two very spiny ridges diverging apically on ventral surface; lower valve of ovipositor with external lateral projection forming a deep ridge across ventral surface of valves.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	38.7-41.0		25.1-29.3	18.8-20.8
Female	51.2	11.5	35.7	22.6



FIGS 38-45. *Hieroglyphus africanus* Uvarov. Male, 38, head and pronotum, from above, 39, end of abdomen, from above; 40, cercus, lateral view; 41, phallic complex, from above, with epiphallus and ectophallic membrane removed; 42, same, lateral view; 43, endophallus, lateral view; 44, epiphallus. Female, 45, subgenital plate and lower valves of ovipositor, ventral view.

MATERIAL EXAMINED

NIGERIA: Deba habe, 23.ix.1970 (G. Popov), 1 ♂; Bajoga, 28-9.x.1970 (G. Popov) 1 ♀; nr Numan, Lamurcle, xi. 1966, 1 ♂; Sherifare, nr Azare, 1924 (J. N. B. Hannington), 1 ♂. SENEGAL: Tambacounda, 10-18.ix.1962 (R. A. Farrow), 1 ♂. UGANDA: Gulu, Acholi, vii. 1929, 1 ♀.

Hieroglyphus nigrorepletus I. Bolívar, 1912

(Text-figs 46-55, Map 2)

Hieroglyphus nigrorepletus Bolívar, 1912 : 56. LECTOTYPE ♀, INDIA: Bellary, ix. 1911 (*Ramachandra*) (IEE, Madrid), here designated [examined].

Hieroglyphus bettoni Kirby, 1914 : 203. LECTOTYPE ♂, INDIA: Moghal Sarai, 20. ix (C. S. Betton) (BMNH), here designated from 2 ♂, 1 ♀ syntypes [examined]. [Synonymized by Uvarov, 1922 : 235.]

Hieroglyphus vastator Carl, 1916 : 481. Holotype ♂, INDIA ('Indes Orient') (MHN, Geneva) [examined]. [Synonymized by Uvarov, 1922 : 235.]

Lectotype ♂. Large and robust. Integument shallow, pitted, shiny. Hairy on three distal abdominal sternites. (Antennae broken.) Fastigium of vertex one-and-a-half times as broad as long; frontal ridge parallel, widening at ocellus. Pronotum with weak median carina; sulci on pronotum deep, posterior margin obtuse-angular, sides expanded in metazona. Prosternal process conical. Mesosternal interspace slightly open; metasternal interspace closed.

Tegmina and wings extending beyond end of abdomen. Hind femur moderately slender. Supra-anal plate angular, with subacute apex. Cercus simple, longer than supra-anal plate, slightly incurved, apex oblique, acute. Subgenital plate subacute.

Phallic complex. Apical valves of penis shorter and broader than valves of cingulum, narrowing at apex; valves of cingulum narrow, upcurved, basal valves of penis robust and broad, dorsal ridge of valves smooth; gonopore process narrowing towards acute apex; zygoma of cingulum narrow; rami broad; apodemes approximately same length as basal valves of penis, broad, narrowing to obtuse apices. Epiphallus very large, with large robust lophi, ancorae small, turned inwards.

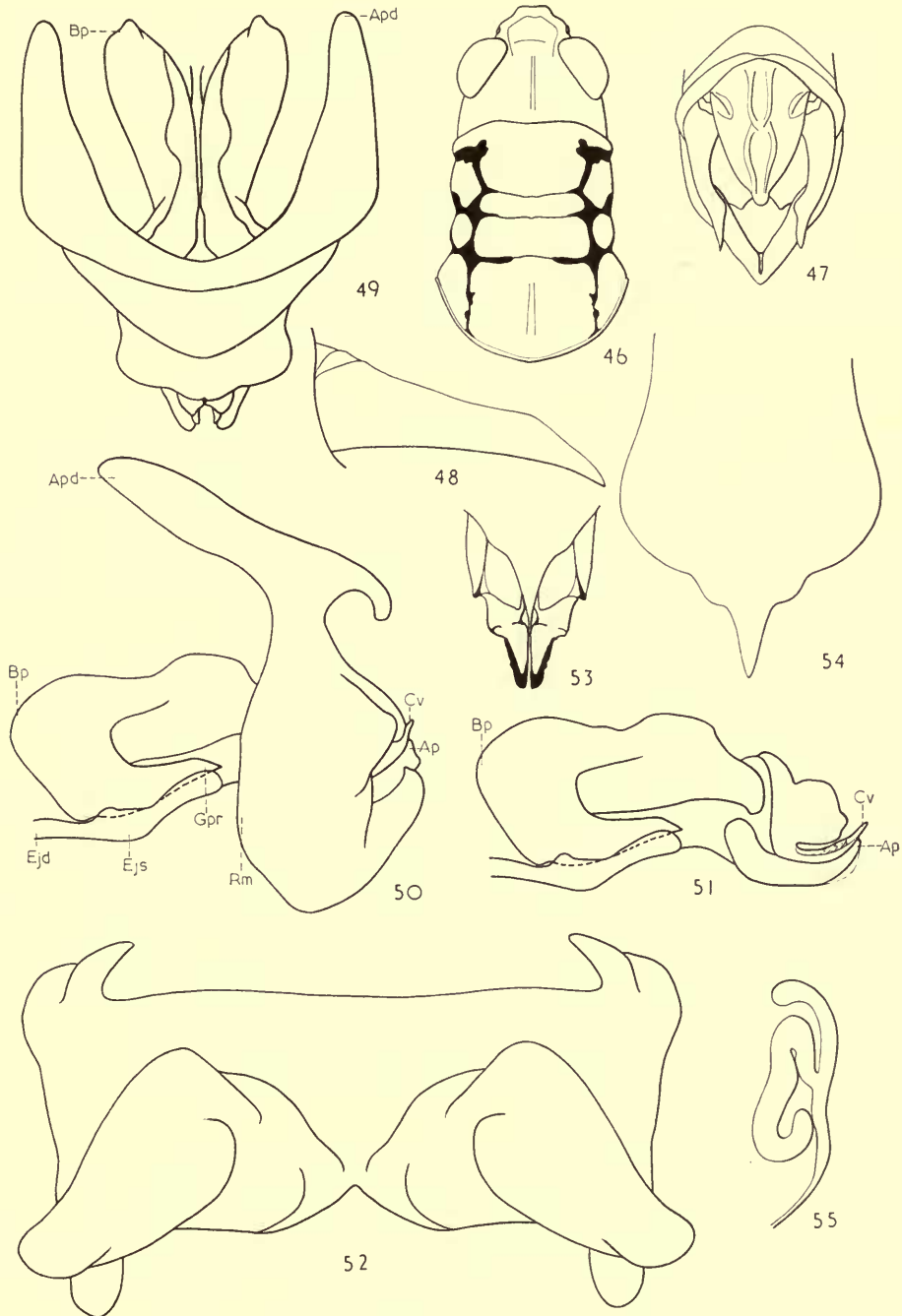
General coloration buff with yellowish buff patches; first, third and fourth sulci of pronotum with broad black bands on sides of pronotum, third sulcus joins first laterally, two broad black parallel bands connect all sulci on dorsum; wing hyaline, veins dark brown or pale buff; hind knee black on inner and outer side, a black patch continues on tibia, spurs of tibia black, tips of spines black, rest of tibia bluish buff.

♀. As the male, but larger. Differs in fastigium of vertex being two-and-a-half times as broad as long; mesosternal interspace more open, subgenital plate with acute median lobe; spermatheca small, apical diverticulum long, narrow, curving back at basal end, preapical diverticulum elongate, half length of apical diverticulum.

Measurements (mm).

	Length of body	Length of pronotum		Length of tegmen	Length of femur
Male	30.3-42.7	7.4-10.4	macropterous:	33.1-35.8	17.7-22.4
			brachypterous:	10.2-19.1	
Female	37.5-48.2	7.5-11.3	macropterous:	38.3	16.9-25.3
			brachypterous:	10.2-16.4	

This species was mentioned in the literature as *H. furcifer* by Cotes (1891) and Maxwell-Lefroy (1906, 1907, 1909), who confused it with *H. banian*, but it has such characteristic markings and shape of the male cerci, that it is difficult to



FIGS 46-55. *Hieroglyphus nigrorepletus* I. Bolivar. Male, 46, head and pronotum, from above; 47, end of abdomen, from above; 48, cercus, lateral view; 49, phallic complex, from above, with epiphallus and ectophallic membrane removed; 50, same, lateral view; 51, endophallus, lateral view; 52, epiphallus. Female, 53, lower valve of ovipositor, ventral view; 54, subgenital plate, ventral view, 55, spermatheca.

understand the confusion. It varies greatly in body-size and tegmina-form; the brachypterous form is more common and frequently more robust. Variation is also found in the general coloration, from greenish buff to buffish brown. The degree of black marking on the pronotum is also variable. The hind tibia varies from bluish green to pale buff.

In the general simple shape and oblique apex of the male cercus, this species is related to *H. africanus*, but differs from it in the robustness of the body, the characteristic breadth and black colouring of the pronotum and the longer male cerci with more acute apices. The phallic complex is also more robust. The female subgenital plate has a small narrow median lobe with an acute apex, unlike *H. africanus*, which has a broad median lobe with a subacute apex.

MATERIAL EXAMINED

INDIA: 1 ♂, 1 ♀; United Provinces, Allahabad, 1 ♂; 13.viii.1909, 1 ♂; 29.vii.1910, 1 ♂, 1 ♀; Bombay, 1 ♂; Jhalod, Punch Mahals, 9.xi.1903, 1 ♂; Borsar, 22.x.1909 (*V. H. Jhakur*) 1 ♂; Bellary Dt. Kotekal, 3.viii.1913, 1 ♂; 2.viii.1912 (*E. Ballard*) 1 ♂; Yemminganur, vii-viii. 1913, 1 ♂; Sarai, 16.ix.1903 (*C. S. Betton*) 1 ♀ (paralectotype of *H. bettoni*); Pachrukhi, Behat, 1927 (*Cornell*), 1 ♀; Surat, 19.viii.1904, 1 ♂; Bikaner, 1 ♂, 1 ♀; Kashmir: Muzaffarabad, 9-12.x.1953, 1 ♂, 1 ♀. PAKISTAN: Karachi, vii-ix (*Maindron*), 1 ♀.

BIONOMICS. The life history was studied in Benares, United Provinces, India (Roonwal, 1945). The hoppers appear in late June to July, soon after the rains. Roonwal states that the duration of the hopper stage is about three weeks. Grist & Lever (1969), however, state that the nymphal development is 71 days at 26°C and 35 days at 32.5°C ± 2.5°C. According to Roonwal (1945) adults begin to appear in late July and mature by the middle of August, when copulation and oviposition occur. According to Chaturvdi (1946) the eggs are laid in the Azangarh district, United Provinces, from mid-September to mid-November, at a soil depth of 2-5 in. Pradhan & Peswani (1961) state that mating lasts 4-24 hours; they also record that the process of egg-laying took 2½ hours. According to Roonwal (1945) the egg-pod contains 20-30 eggs. Pradhan & Peswani (1961) state that 23-53 (average 39) eggs are found per pod. Roonwal (1945) states that the adults die off towards the end of August or the beginning of September.

Wesley (1946), Rao & Cherian (1940), and Main (1912) state that the life history is similar to that of *H. banian*.

ECOLOGY. The Phadka Grasshopper (native name) is found in India and Pakistan. It feeds on rice, but is also reported by Bhatia, Singh & Ahluwalia (1965) in arid-zone regions. Pradhan & Peswani (1961) state that the young nymphs remain in the bunds and mounds for about a fortnight and feed on weeds. They also state that nymphs and adults swim in water. It has been found feeding on the following plants:

Andropogon halepensis (native name: baru) (Bhatia, Singh & Ahluwalia, 1965)
A. sorghum (cholan, and jowar millets) (Roonwal, 1945)

Brachiaria sp. (Pradhan & Peswani, 1961)
Cannabis sativa (hemp) (Roonwal, 1945)
Capparis aphylla (kair) (Bhatia, Singh & Ahluwalia, 1965)
Dactyloctenium aegyptium (Pradhan & Peswani, 1961)
Eleusine coracana (Sengupta & Behura, 1951)
Oryza sativa (Roonwal, 1945)
Pennisetum cenchroides (dhaman) (Bhatia, Singh & Ahluwalia, 1965)
P. typhoideum (bajra) (Roonwal, 1945)
Phaseolus aconitifolius (Bhatia, Singh & Ahluwalia, 1965)
P. mungo (Bhatia, Singh & Ahluwalia, 1965)
Saccharum officinarum (sugar cane) (Roonwal, 1945)
S. spontaneum (kard) (Bhatia, Singh & Ahluwalia, 1965)
Salvador persica (jal) (Bhatia, Singh & Ahluwalia, 1965)
Setaria italica (tenai or Indian millet) (Roonwal, 1945)
Veronia sp. (Pradhan & Peswani, 1961)
Zea mays (Roonwal, 1945)
 Bhatia (1951) states that it also infests sesame and cotton.

ECONOMIC IMPORTANCE. This species is an important pest of rice, sugar-cane, hemp, maize and sorghum in the Indo-Pakistan subcontinent (Ghouri & Ahmed, 1960). Bhatia (1951) records that 207,218 acres of cultivated land were infested by it, comprising 50% jowar, 25% bajra, 20% sesamum and 5% cotton. It was also present in 197,000 acres of uncultivated land and 11,919 acres of forest. It is a most serious pest in Ajmer-Merwara, India (Bhatia, 1950). In 1948, 75% of village cultivations were infested by it and the estimated area was 112,707 acres. It has been reported from Ajmer-Merwara and adjoining areas of Udaipur, Jodhpur and Kishergarh as a serious pest of maize and jowar (Anon., 1951a). Chaturvedi (1946) states that it is a serious though sporadic pest of sugar-cane, maize and juar (*Andropogon sorghum*) in the eastern parts of the United Provinces, India. Pradhan & Peswani (1961) also consider it a serious pest in India, but do not give further details. Main (1912) states that it is recorded from Sind, Las Bela and Mekran. It is a fairly serious pest on jowar in certain other localities. Grist & Lever (1969) regard it as of less economic importance than *H. banian*, but they state that it feeds on *Andropogon sorghum* (juar), *Setaria*, millet, rice and sugar cane. It is recorded as a serious pest of maize (*Zea mays*), jowar (*Sorghum vulgare*) and bajra (*Pennisetum typhoideum*) in the states of Madras, Bombay, Madhya Pradesh, Bihar, Uttar Pradesh, Rajasthan, Andhra Pradesh, Orissa and Delhi (Bhatia, Charan Singh & Ahluwalia, 1965). Roonwal (1945) records it as a minor pest of millets *Andropogon sorghum*, *Pennisetum typhoideum* and *Setaria italica* and also of *Oryza sativa* (rice), *Zea mays* (maize), *Cannabis sativa* (hemp) and *Saccharum officinarum* (sugar-cane).

Sengupta & Behura (1960) report notable outbreaks of this species in 1945 in Orissa. The average damage to crops was 25%. The distribution given includes the states mentioned above, with the addition of Assam, Mysore, Punjab and West Bengal. It is recorded as a major pest in Rajasthan, active from July to

October. In severely infested fields the crop is totally destroyed. The leaves are nibbled in the nurseries and the insects finally reach the transplanted fields (Khan, Vyas & Vaish, 1963). Severe epidemics completely defoliate sugar-cane in Uttar Pradesh and Orissa (Gupta & Saxena, 1963).

Welsey (1946), Rao (1956) and Fletcher (1920) considered it as of not much economic importance in certain upland areas of Madras, Punjab and Andhra Pradesh.

SWARMING BEHAVIOUR. The macropterous form is reported only occasionally, the majority of specimens found being brachypterous. However, Ghouri & Ahmed (1960) reported that a medium-size swarm passed over Malir (Pakistan) and 500 specimens collected were fully macropterous. Other smaller swarms were reported in Bela, Karachi, Malir, Thatta and parts of Hyderabad. The age and movement of the swarms indicated that they originated near Karachi. It was thought that arid conditions between 66° and 71° E longitude and 24° and 27°N latitude were favourable for transformation from non-swarmling to swarming populations. The same authors also stated that reclamation of desert in Pakistan was continuously extending the areas favourable for breeding by this species.

PREDATORS AND PARASITES

Fungi:

Empusa [*Entomophthora*] *grylli* Fres. After heavy rains in 1929 and 1930 hoppers were found infested (Wesley, 1946).

Nematodes:

Cordius sp. (probably) (Wesley, 1946)

Mermis nigrescens Duj. (Wesley, 1946).

Mites:

Eutrombidium trigonum Hermann (Peswani, 1961)

Trombidium sp. Larva of a small reddish mite reported on bodies of adults (Peswani, 1961).

Frogs:

Rana sp. (attacking nymphs) (Wesley, 1946).

Snakes:

Tropidonotus piacetus (feeding on nymphs) (Wesley, 1946).

Birds (Wesley, 1946):

Acridotheres tristis L. (Mynah)

Coracias indica L. (Indian Roller)

Corvus splendens Vieill (Common Crow)

C. macrorhynchus Waglar (Jungle Crow)

Dicrurus macrocercus Vieill (King Crow)

Baliastur indus Bodd (Brahmani Kite)

Mileus govinda Sykes

Ducks are used by local cultivators to check hoppers.

Mammals (Wesley, 1946):

Microchiroptera sp. (devouring adults at light at night)

Excreta of jackals (probably) contained *Hieroglyphus*.

Hieroglyphus daganensis Krauss, 1877

(Text-figs 56-67, Map 1)

Hieroglyphus daganensis Krauss, 1877 : 42. LECTOTYPE ♂, SENEGAL: Dagana, x-xii.1868 (*F. Steindachner*) (NM, Vienna), here designated [examined].

Hieroglyphus daganensis var. *abbreviata* Krauss, 1877 : 43. LECTOTYPE ♀, SENEGAL: Dagana, x-xii.1868 (*F. Steindachner*) (NM, Vienna), here designated. **Syn. n.**

♂. Very large. Moderately robust. Integument coarsely pitted. Hairy on ventral surface. Antenna 28-segmented. Fastigium of vertex slightly more than one-and-a-half times as broad as its length; carinula of vertex weak; frontal ridge divergent downwards with deep sulcus. Sulci on pronotum moderately deep, the posterior sulcus bow-shaped at centre, posterior margin of metazona rounded, sides relatively straight. Prosternal process conical. Mesosternal interspace closed; metasternal interspace closed.

Tegmina and wings extending slightly beyond end of abdomen. Hind femur moderately slender. Supra-anal plate with broad attenuate apex which is subacute. Cercus simple, same length as supra-anal plate, upcurved and recurved at subacute apex. Subgenital plate with sulcate and emarginate apex.

Phallic complex. Apical valves of penis slightly shorter than valves of cingulum, apex rounded; valves of cingulum moderately broad, apex rounded; basal valves of penis robust, slightly expanded at ends, dorsal ridge of valve smooth; gonopore process broad, narrowing to subacute apex; zygoma of cingulum moderately broad; rami broad; apodemes widely arcuate; shorter than basal valves of penis, narrowing to rounded apex. Epiphallus large, with broad bridge, lobes of lophi rounded; ancorae small.

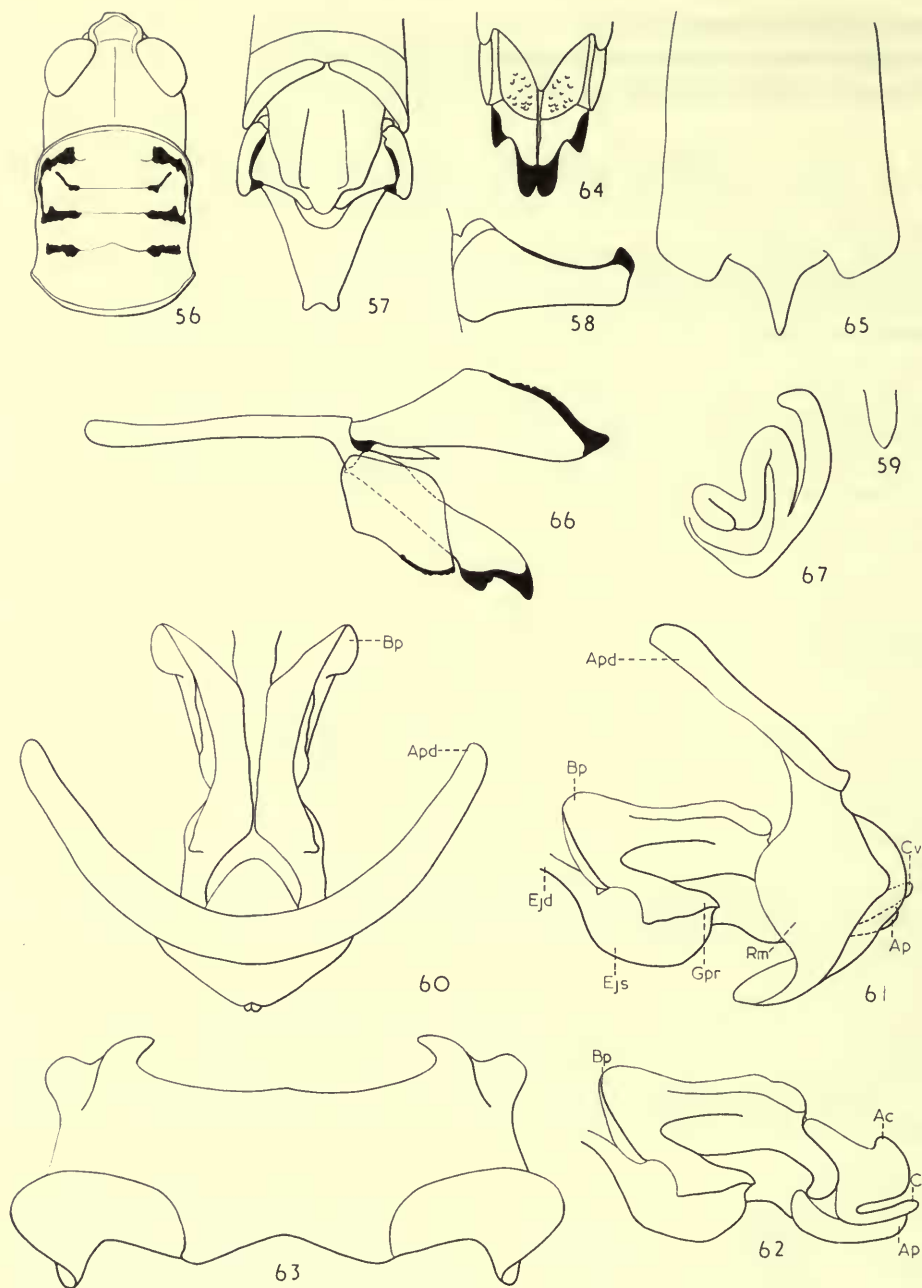
General coloration pale green or buff with yellowish buff patches, sulci on pronotum with broad black bands on sides of pronotum, second sulcus with black bands laterally, pointing anteriorly, third sulcus joins first laterally, dorsum of pronotum pale green; sides of thorax with black bands between segments; wings hyaline, veins pale green, buff or brown; hind femur green, or buff with reddish tinge near knee, hind knee with black patch on inner and outer side, continuing on base of tibia, tibia bluish green; tips of spines black, spurs black, apex of cercus black.

♀. As the male, but larger. Differs in fastigium of vertex two-and-a-half times broader than its length; mesosternal interspace slightly open, subgenital plate trilobate with outer lobes angular and much shorter than median lobe, median lobe subacute; valves of ovipositor short and robust; external lateral projection of lower valve large, obtuse-angular, spermatheca small, apical diverticulum long, narrow, curving back at basal end, preapical diverticulum elongate, half length of apical diverticulum.

Measurements (mm).

	Length of body	Length of pronotum		Length of tegmen	Length of femur
Male	33.9-43.5	6.9-8.1	macropterous:	24.8-33.5	16.1-20.5
			brachypterous:	14.1-17.5	
Female	50.9-57.6	10.3-12.3	macropterous:	38.2-41.4	25.0-26.6
			brachypterous:	16.9-21.6	

This species varies greatly in body-size and coloration. The reddish colour on the hind femur is not always present and may be associated with sexual maturation.



FIGS 56-67. *Hieroglyphus daganensis* Krauss. Male, 56, head and pronotum, from above; 57, end of abdomen, from above; 58, cercus, lateral view; 59, prosternal tubercle, lateral view; 60, phallic complex, from above, with epiphallus and ectophallic membrane removed; 61, same, lateral view; 62, endophallus, lateral view; 63, epiphallus. Female, 64, lower valves of ovipositor, ventral view; 65, subgenital plate, ventral view; 66, ovipositor, lateral view. 67, spermatheca.

The same coloration is also found in *H. perpolita*. The degree of black markings on the pronotum is also variable, but the dorsum of the pronotum is without black bands on the sulci as in *H. nigrorepletus*. The general coloration varies from buff to yellowish green.

H. daganensis varies in tegmina length, having both macropterous and brachypterous forms. The brachypterous forms were described by Krauss (1877) as *H. daganensis* var. *abbreviata*; they are very common.

This species is very closely related to the Indian species *H. oryzivorus*. These two species are separated from the rest by the shape of the posterior margin of the pronotum, and the shape of the male cercus. However, these are not sufficiently important characters to warrant placing these species in separate genera. Investigation of the phallic complex also confirms that they all belong to the same genus.

MATERIAL EXAMINED

MALI: Macina, Kara, 12.ix.1959 (*G. Popov*), 2 ♀; Nr. Menaka, 25.ix.1959 (*G. Popov*), 1 ♂, 3 ♀; Between Menaka and Mantas, the Valley of Azovak, 27.ix.1959 (*G. Popov*), 1 ♂; Nr. Douenza, 8.x.1959 (*G. Popov*), 1 ♀; Sangha Village, viii. 1962 (*N. D. Jago*), 1 ♂; Hombori, 29.viii.1962 (*N. D. Jago*), 2 ♂, 1 ♀. SENEGAL: Bambey, 1946 (*J. Risbec*), 2 ♂; Thies, 22.ix.1962 (*R. A. Farrow*), 1 ♂; Tambacounda, 10–18.ix.1962 (*R. A. Farrow*), 1 ♀; Kaolack, 11–19.ix.1962 (*R. A. Farrow*), 7 ♂, 3 ♀; Dakar, 1949–1950, 1 ♀; Mbao, 21–26.viii.1962 (*R. A. Farrow*), 1 ♂. ETHIOPIA: Nr. Barentu, 5.x.1957 (*D. J. Greathead*), 1 ♂. SAHARA: Agades, Triwalam, 28.ix.1965 (*G. Popov*), 1 ♀. CHAD: Kara, 1. 1957 (*J. T. Davey*), 2 ♂; Ouadai, Abecher, 1 ♂. KENYA: N. du Lac Rodolphe, Riv Bass entre les Mts Nakoua et Galebi, vi. 1903 (Mission du Bourg de Bozas), 1 ♀. IVORY COAST: Odienné, 4.xi.1966 (*B. Guessan*), 1 ♂. SUDAN: Gedaref, x. 1946 (*R. J. V. Joyce*), 1 ♂; Wad Medani, 27.viii.1930 (*W. P. L. Cameron*), 1 ♂; Kodok, 27.viii.1929 (*M. M. Smail*), 2 ♂, 1 ♀; Um Dona, Koalib, 22.x.1927 (*W. Rutledge*), 1 ♀; Singa, 12.x.1927 (*H. B. Johnston*) 3 ♂, 2 ♀. NIGERIA: Kalkala, 17.x.1933 (*A. M. Gwynn*) 1 ♂, 2 ♀; 10.ix.1934, 1 ♂; 20.ix.1933, 1 ♀; Mongonu, 28.ix.1931 (*F. D. Golding*), 2 ♂, 1 ♀; Numan, Adamawa, 2.xii.1966, 1 ♀; Numan 21.ix.1948 (*A. Jorgensen*), 1 ♂; Argungu, 21.x.1910 (*C. E. S. Watson*), 1 ♂, 5 ♀; Shangjüre, Azare, 1924 (*J. W. B. Hanington*), 1 ♂; Birnin Kebbi (*C. E. S. Watson*), 1 ♂; Dongo, 14.xi.1931 (*F. D. Golding*), 1 ♂; Bajoga, 28.ix.70 (*G. Popov*), 1 ♂, 1 ♀; Gumari, 2 km W. of Gajbo, 15.xii.1949 (*H. B. Johnston*), 1 ♂. NIGER: Nr. Tahoua, 2.ix.1960 (*G. Popov*), 2 ♂, 1 ♀; Ansongo, 1.v.1928 (*H. Madsen*), 1 ♀.

BIONOMICS. In Nigeria this species survives the dry season in the egg stage (Popov, 1959). According to Golding (1948) the adults appear at Kalkala, Nigeria, between August and November, being most numerous in October. There is an embryonic diapause from November to about July.

ECOLOGY. This species appears in marshes in Nigeria north of 12°N. It feeds on grasses notably *Brachiaria*, *Echinochloa*, *Andropogon* sp., *Sorgum aethiopicum* and bulrush millet (Golding, 1948). Joyce (1952) reports that it mostly favours unburnt virgin land in East Central Sudan and is most abundant in areas with good graminaceous vegetation and light rainfall during the hatching period. Popov

(1959) records that it is common in woodlands away from cultivations, in the Sudan-Chad area.

ECONOMIC IMPORTANCE. As many individuals are brachypterous and therefore not flyers they seldom move into crops (Joyce, 1952). However, Popov, (1959) states that in the eastern Chad and Dafur area they cause considerable damage to millet cultivation (*Pennisetum typhoideum*). The species was widespread in the Sahelian belt extending south to the Sudanian belt. Mallamaire (1956) reported that it damaged young seedlings of *Arachis hypogea* in French West Africa.

Hieroglyphus oryzivorus Carl, 1916

(Text-figs 68-77, Map 1)

Hieroglyphus oryzivorus Carl, 1916 : 480. LECTOTYPE ♀, INDIA: Murshidabad (MHN, Geneva), here designated [examined].

♂. Medium size. Moderately slender. Integument finely and shallowly pitted. Hairy on ventral surface. (Antennae broken.) Fastigium of vertex twice as broad as long; carinula of vertex absent; frontal ridge divergent downwards with moderately shallow sulcus. Sulci on pronotum moderately deep, the posterior sulcus bow-shaped at centre, posterior margin of metazona rounded. Prosternal process conical. Mesosternal interspace closed; metasternal interspace closed. Apices of folded tegmina and wings approximately level with tip of abdomen. Hind femur moderately slender. Supra-anal plate with relatively broad apex, which is subacute. Cercus simple, same length as supra-anal plate, upcurved and incurved with apex subacute. Subgenital plate with sulcate and truncate apex.

Phallic complex. Apical valves of penis stouter and shorter than valves of cingulum, apex subacute. Valves of cingulum narrow, elongate with rounded apices; basal valves of penis robust, expanded at ends, dorsal ridge of valves smooth; gonopore process elongate, narrowing to subacute apex; rami broad; apodemes U-shaped, slightly shorter than basal valves of penis, and slightly expanded before rounded apex. Epiphallus of medium size, lobes of lophi rounded with second lobe facing inwards, ancorae small.

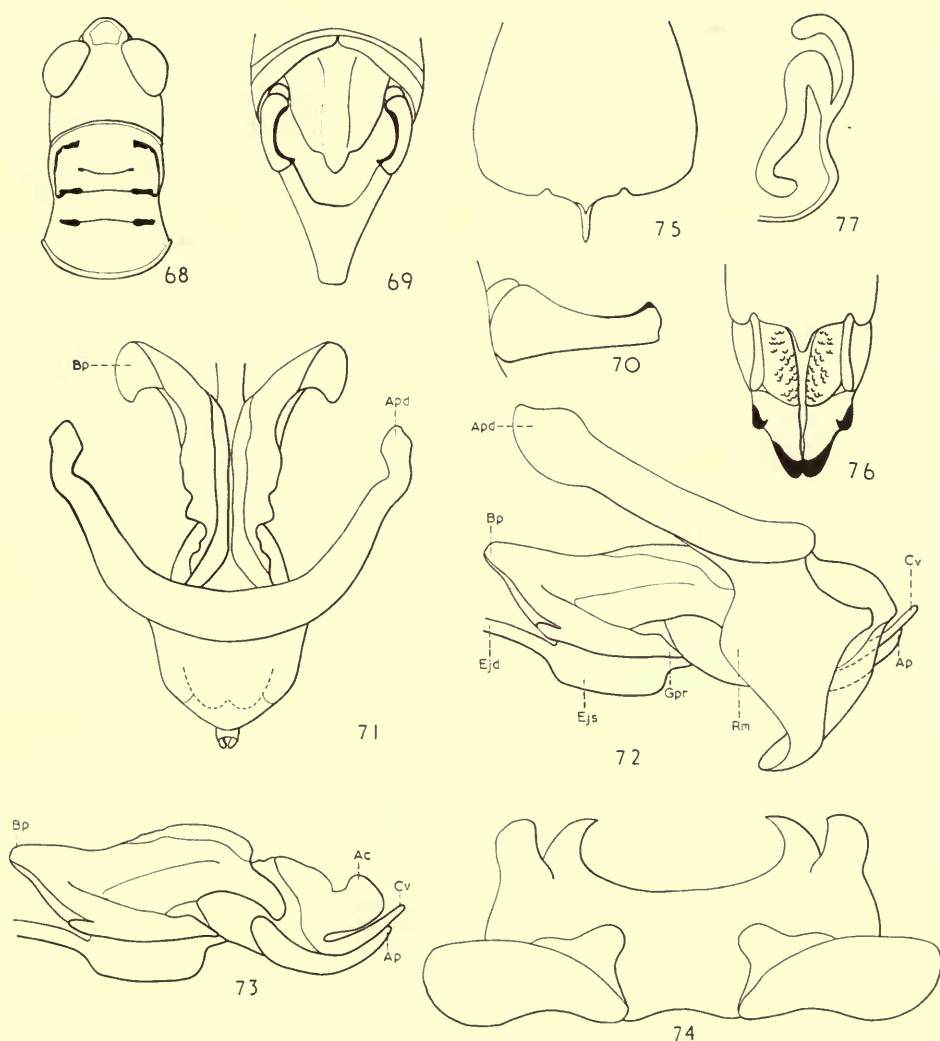
General coloration pale green or buff with yellowish brown patches, sulci on pronotum with broad black bands laterally, second sulcus with only small black patches each end, third sulcus joins first laterally, dorsum of pronotum pale green with narrow, pale brown sulci, sides of thorax with black bands between segments; wing hyaline, veins pale green, buff or brown. Hind femur buff with reddish tinge, hind knee without black patches, tibia pale bluish green, tips of spines and spurs black; tip of cercus black.

♀. As the male, but larger, differs in fastigium of vertex being nearly three times as broad as long; mesosternal interspace open; subgenital plate trilobate with outer lobes rounded and small, much shorter than median lobe, median lobe pointed. Valves of ovipositor very short and robust; external lateral projection of lower valve small, obtuse; spermatheca small, apical diverticulum long, narrow, curving back at basal end, preapical diverticulum elongate, half length of apical diverticulum.

Measurements (mm).

	Length of body	Length of pronotum		Length of tegmen	Length of femur
Male	35.0-35.4	5.4-7.1	macropterous:	20.5-23.7	15.7-18.9
Female	42.7-63.3	7.6-10.2	macropterous:	33.5	19.6-28.3
			brachypterous:	17.6-28.4	

This species is very closely related to *H. daganensis*, and is very similar in appearance and difficult to differentiate. It has been retained as a species distinct from *H. daganensis* because of the following characters. The body is smaller. The apex of the male cercus is not elongate, and the apex of the subgenital plate is truncate, not emarginate as in *H. daganensis* (though this character is not always constant in *H. daganensis*). The female subgenital plate is of different shape; in



FIGS 68-77. *Hieroglyphus oryzivorus* Carl. Male, 68, head and pronotum, from above; 69, end of abdomen, from above; 70, cercus, lateral view; 71, phallic complex, from above, with epiphallus and ectophallic membrane removed; 72, same, lateral view; 73, endophallus, lateral view; 74, epiphallus. Female, 75, subgenital plate, ventral view; 76, lower valves of ovipositor, ventral view; 77, spermatheca.

H. oryzivorus the lateral lobes are very small and rounded; the median lobe is also small. The phallic complex also gives good characters. The valves of the cingulum are elongate and narrow, while in *H. daganensis* they are shorter and thicker. The epiphallus possesses an extra lobe on the lophi, which faces inwards; this is absent in *H. daganensis*. *H. oryzivorus* is from India, *H. daganensis* from Africa.

Like *H. daganensis*, this species has both macropterous and brachypterous forms. In the specimens studied by the author the males are macropterous and the females, with only one exception, brachypterous.

This species was described by Carl from two females; a lectotype has been designated. Carl attributed his specimens to the species mentioned by Maxwell-Lefroy (1906) as *H. furcifer*. However, in Maxwell-Lefroy (1906), fig. 8 of plate X shows the male cercus of *H. nigrореpletus* and fig. 4 of plate VIII is like *H. banian* in the shape of the pronotum and not *H. oryzivorus* as Carl suggests.

MATERIAL EXAMINED

INDIA: Mungeli, Bilaspur, 25.x.1906, 1 ♂; nr Bikaner, Udramsar, 20.viii.1963 (G. Popov), 1 ♀; Rampur, 13.x.1903, 1 ♀; Bombay, 1 ♀; Khurda, 11.xi.1913, 5 ♀; Godavari (Dt. Samalkot), 11.xi.1921 (Y. R. Rao), 2 ♂; 16-18.xi.1921, 1 ♂, 2 ♀. PAKISTAN: Amgare, Sind, vii. 1932, 1 ♂; Mekran, Pidark, xii. 1933 (F. M. Turbat), 1 ♂.

Rao & Cherian (1940) record it from INDIA: Ganjam, Vizagapatam, Godavari and possibly Bellary. Uvarov (1922) records it from INDIA: Bombay Province, Pardi, 23.ix.1904; Khurda, 11.xi.1913; Kasal-Mardvi, 25.x.1903; Jhalod, Panch Mahals, 9.xi.1903; Central Provinces, Raipur, 13.x.1903; Mungeli, Belaspur 25.x.1906, and S. India.

BIONOMICS. There is very little published information about this species. The eggs are laid from the middle of September to the middle of November at a depth of 2-5 inches in the soil (Janjua, 1957) and develop the following June-July. The nymphs hatch in July and pass through six instars before becoming adult. There is only one generation a year. They feed on grasses.

ECONOMIC IMPORTANCE. The food-plants of economic importance are rice, jowar and sugar-cane, but *H. oryzivorus* is primarily a serious pest of rice. The damage is identical to that of *H. banian*. Together with *H. banian* it has been recorded as a serious pest of rice in two areas in Madras (Anon., 1933).

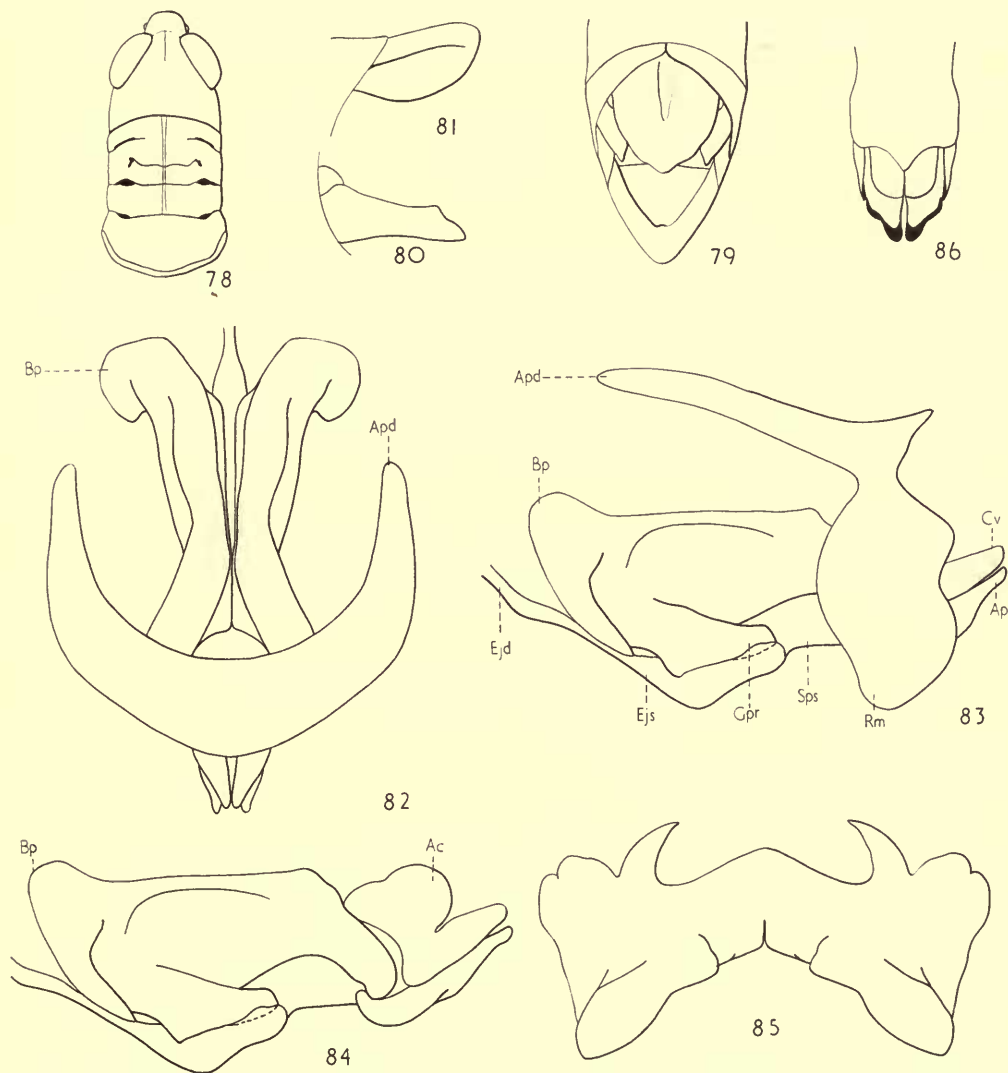
Hieroglyphus indicus sp. n.

(Text-figs 78-86, Map 1)

Holotype ♂. Comparatively small, moderately slender. Integument finely pitted, hairy on ventral side. Antenna 27-segmented. Fastigium of vertex twice as broad as long; carinula of vertex weak; frontal ridge widened downwards, with shallow sulcus. Pronotum with median carina almost entire; sulci on pronotum moderately deep, posterior sulcus slightly bow-shaped towards the centre, posterior margin obtuse-angular, sides relatively straight. Prosternal process conical. Mesosternal interspace open; metasternal interspace closed.

Tegmina and wings micropterous, reaching second abdominal segment. Hind femur moderately slender. Supra-anal plate plain with obtuse-angular apex. Cercus nearly as long as supra-anal plate, moderately robust, shallowly bilobate, apex oblique with the lower part elongate and the apex subacute. Subgenital plate with subacute apex.

Phallic complex. Apical valves of penis same length as valves of cingulum, rounded at apices; valves of cingulum broad at truncate apex; basal valves of penis robust, expanded at end, dorsal ridge of valves smooth; gonopore process broad, narrowing to oblique apex; zygoma



FIGS 78-86. *Hieroglyphus indicus* sp. n. Male paratype, 78, head and pronotum, from above; 79, end of abdomen, from above; 80, cercus, lateral view; 81, tegmen; 82, phallic complex, from above, with epiphallus and ectophallic membrane removed; 83, same, lateral view; 84, endophallus, lateral view; 85, epiphallus. Female paratype, 86, subgenital plate and lower valves of ovipositor, ventral view.

of cingulum broad, rami moderately broad; apodemes U-shaped, shorter than basal valves of penis, narrowing to rounded apex. Epiphallus large, with tendency to divide at base; lophi with two pairs of lobes, one pair pointing inwards and one outwards; ancorae moderately long.

General coloration pale green and buff, sulci on pronotum broadly black on lateral lobes, green on dorsum; sides of thorax greenish buff; tegmina yellowish green, wings hyaline; hind femur pale reddish brown with black patches on both sides of knee; tibia greyish green with black underside, tips of spines and spurs black.

♀ (paratype). As the male, but larger. Differs in that fastigium of vertex is three times as broad as long; mesosternal interspace more widely open, subgenital plate forming acute apex; valves of ovipositor short and robust, external lateral projection of lower valve rounded.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of femur
Male	26.7-27.2	6.0-6.5	4.9-5.1	14.0-14.9
Female	41.6	9.4	7.6	20.7

This species has a similar type of pronotum to that of *H. daganensis* and *H. oryzivorus* but differs from them in the shape of the male cercus, which is not upcurved at the apex but bilobate and oblique. It is therefore a link between them and the rest of the species of the group. The female subgenital plate and ovipositor valves are similar to those of *H. tonkinensis*. *H. indicus* differs from the other species studied in that the apical valves of penis are of the same length as the cingulum valves; in the other species the apical valves are shorter.

MATERIAL EXAMINED

Holotype ♂, INDIA: Bombay, Khandala, 12.x.1928 (IEE, Madrid).

Paratypes. 1 ♂, 1 ♀, same data and depository as holotype.

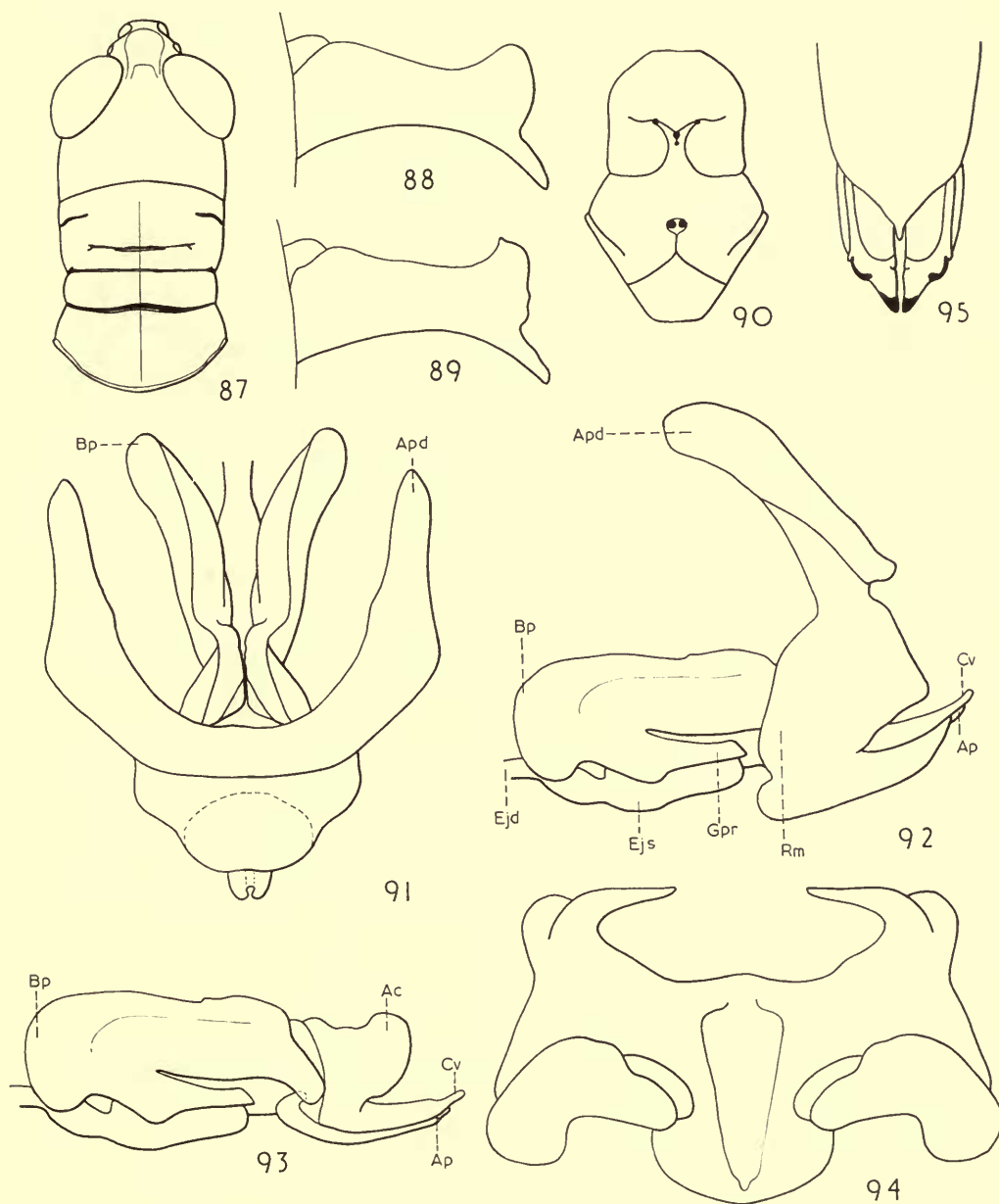
Hieroglyphus tonkinensis I. Bolívar, 1912

(Text-figs 87-95, Map 3)

Hieroglyphus tonkinensis I. Bolívar, 1912 : 54. Holotype ♂, VIETNAM (NORTH): Hanoi (IEE, Madrid) [examined].

♂. Medium size. Comparatively slender. Integument finely pitted. Fastigium of vertex broader than long; occipital carinula absent; frontal ridge with shallow sulcus, lateral carinulae well defined, straight, widening between antennae and converging above. Median carina of pronotum weak, disappearing in pronzona, crossed by second, third and posterior sulci; the first sulcus present only laterally, the second only centrally, the third and posterior sulci entire. All sulci slightly wavy, metazona about half length of prozona, posterior margin of metazona obtuse-angular, almost rounded. Prosternal process conical. Mesosternal interspace open, about twice as long as its width in middle; metasternal interspace closed. Tegmina and wings reaching to, or just beyond end of abdomen. Hind femur slightly shorter than abdomen. Hind tibia slightly shorter than hind femur. Supra-anal plate longer than wide with two ridge-like elevations, median sulcus disappearing at centre but continuing at basal part. Cercus broad, at apex bilobate, upper lobe broad with rounded or slightly sinuate outer edge; lower lobe elongate, narrow and pointed. Subgenital plate narrowing to subacute apex.

Phallic complex. Apical valves of penis shorter than valves of cingulum, narrowing at apices; valves of cingulum tapering at apices; basal valves of penis moderately robust with



FIGS 87-95. *Hieroglyphus tonkinensis* I. Bolívar. Male, 87, head and pronotum, from above; 88, cercus, lateral view; 89, variation of cercus, lateral view; 90, meso- and metasternum; 91, phallic complex, from above, with epiphallus and ectophallic membrane removed; 92, same, lateral view; 93, endophallus, lateral view; 94, epiphallus. Female, 95, subgenital plate, and lower valves of ovipositor, ventral view.

sides extending, dorsal ridge of valves smooth but curved; gonopore process large, elongate, narrowing at apex; zygoma of cingulum wide and moderately broad, rami broad; apodemes almost reaching ends of basal valves of penis, horse-shoe shaped, narrow towards obtuse apex. Epiphallus bridge-shaped with large central protrusion at base; ancora elongate with acute apices; lophi large with two inner lobes, and sinuate outer edges.

General coloration green or yellowish green with yellowish brown patches; all sulci on pronotum black; wing hyaline, veins dark and pale brown; hind knee with black patches on both sides; tibia blue, at base black, apical part and tips of spines black.

♀. As male, but larger. Differs in fastigium of vertex being twice as broad as long; subgenital plate with one pointed median lobe; lower valves of ovipositor short, outer lateral projection of lower valve rounded or ill-defined.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	32.4-38.1	6.6-6.8	25.7-26.1	17.5-18.7
Female	42.7	8.7	32.4	23.1

This species is related to *H. banian* but differs from it in the broad male cerci, with the upper lobe wide with sinuate or rounded edge, and the lower lobe long and pointed. The ovipositor valves are short, the lower valve with a poorly defined outer lateral projection. The mesosternal interspace is open. The phallic complex is similar to *H. banian* but differs mainly in the epiphallus possessing a thick bridge with a large central protrusion; the ancora are longer and more acute.

H. tonkinensis I. Bolívar, 1912 must not be confused with *H. tonkinensis* Carl, 1916, which is a junior synonym of *H. annulicornis* (Shiraki, 1910).

MATERIAL EXAMINED

VIETNAM (NORTH): Thanh Hoa, 10.xii.1901 (*H. Fruhstorfer*), 2 ♂; vi-vii (*H. Fruhstorfer*), 1 ♂, 1 ♀; Hanoi, 1910 (*Monceau*), 1 ♂; region de Hoa Binh 1930 (*A. de Cooman*), 1 ♂. HAINAN I.: S.W. Nodda, 28.vi.1929, 2 ♂, 8.vii.1929, 1 ♀, 2.vi.1929, 1 ♂. THAILAND: Bangkok, 1908 (*Collin de Plancy*), 1 ♂; Chumphon, 10°30'N, 99°11'E, 15.vi.1958 (*M. C. Lak Kashimsonta*), 2 ♂; Sakonnakhon, 3.viii.1956 (*Ch. Butalobol*), 1 ♂; Sukhothai, 10.vii.1961 (*P. Kaen Tasee*), 1 ♂. CHINA: Kwangtseh-Fukien, 22.ix.1937 (*J. Klapprich*), 1 ♀.

ECONOMIC IMPORTANCE. Tinkham (1936) records that this species is an injurious pest of rice and sugar-cane from Hupeh to Cochin China (South Vietnam). Mishchenko (1952) states that it causes damage to rice, sugar-cane and bamboo.

Very little is known about this species, possibly because it is confused with *H. banian*, a very closely related species.

Hieroglyphus banian (Fabricius, 1798)

(Text-figs 1, 96-106, Map 4)

Gryllus banian Fabricius, 1798 : 194. LECTOTYPE ♂, INDIA (UZM, Copenhagen), here designated from 1 ♂, 2 ♀ syntypes [examined].

Acridium furcifer Serville, 1839 : 677. 3 ♂ syntypes, INDIA: Bombay (lost). [Synonymized by Uvarov, 1922 : 237.]

Hieroglyphus banian var. *elongata* Uvarov, 1922 : 238. Holotype ♂, BANGLADESH: Faridpur (BMNH) [examined]. **Syn. n.**

♂. Medium size. Integument finely rugose and pitted. Fastigium of vertex as broad as long, with an elongate depression in middle; occipital carinula weak; frontal ridge with moderately deep sulcus and clearly developed lateral carinulae converging at upper end. Pronotum of pronotum longer than metazona; median carina weak but present along whole length of dorsum; crossed by three sulci; first sulcus present only laterally, second only centrally, third and posterior sulci entire, second and third slightly wavy; posterior margin of metazona obtuse-angular. Prosternal process conical. Mesosternal interspace open, about twice as long as wide in middle; metasternal interspace closed. Tegmina and wings reaching end of abdomen. Tympanal organ with subtympantal ridge, small dorsal shell covering, membrane moderately depressed. Hind femur moderately slender, reaching end of abdomen. Hind tibia only slightly shorter than hind femur. Supra-anal plate longer than wide in apical part with two ridge-like elevations, median sulcus disappearing at centre but present in basal part. Cercus slender, bifurcate with upper branch incurved, and recurved. Subgenital plate in profile elongate, upcurved above rest of abdomen, narrow at apex, subacute.

Phallic complex. Apical valves of penis shorter than valves of cingulum, narrowing at rounded apices; valves of cingulum tapering at apices; basal valves of penis moderately robust with sides extending at apices, dorsal ridge of valves smooth; gonopore process large, elongate, narrowing at apex; zygoma of cingulum wide and moderately broad, rami broad; apodemes almost reaching ends of basal valves of penis, horse-shoe-shaped, narrowing towards obtuse apices. Epiphallus bridge-shaped, with central protrusion at base; ancorae with acute apices; lophi large with two inner lobes, and sinuate outer edges.

General coloration green or yellowish brown, with yellowish brown patches; antennae brown with yellow stripes; all sulci on pronotum black; wing hyaline, veins dark and pale brown; hind femur greenish buff, hind knee with black patches on both sides; base of tibia black above, tibia bluish grey, tips of spines black, tips of bifurcate cercus black.

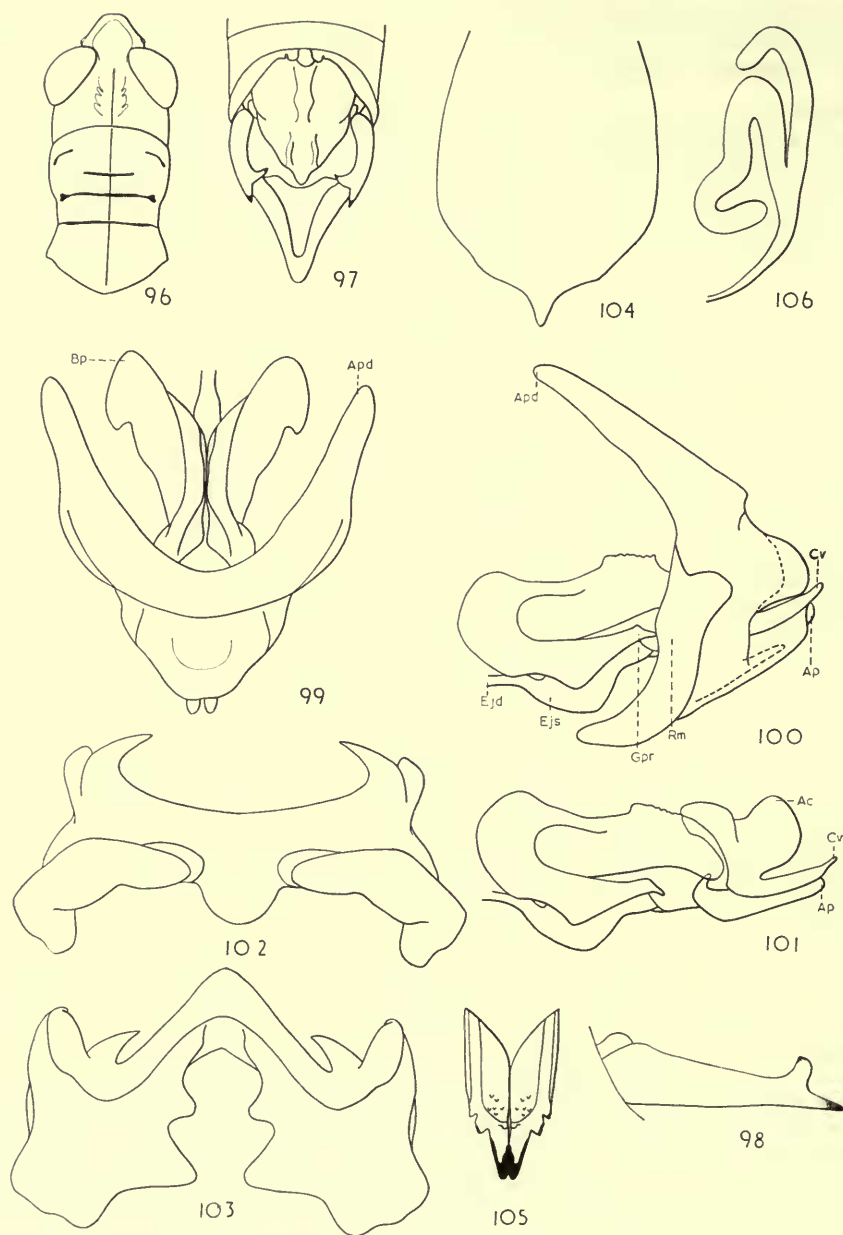
♀. As the male, but larger. Differs in fastigium of vertex being broader than long; subgenital plate simple, with one pointed median lobe; lower valves of ovipositor narrow, elongate, with two well defined teeth on each side.

Spermatheca large, apical diverticulum moderately narrow, elongate, curving back basally and apically; preapical diverticulum also elongate, shorter than apical diverticulum, curving back at apical end.

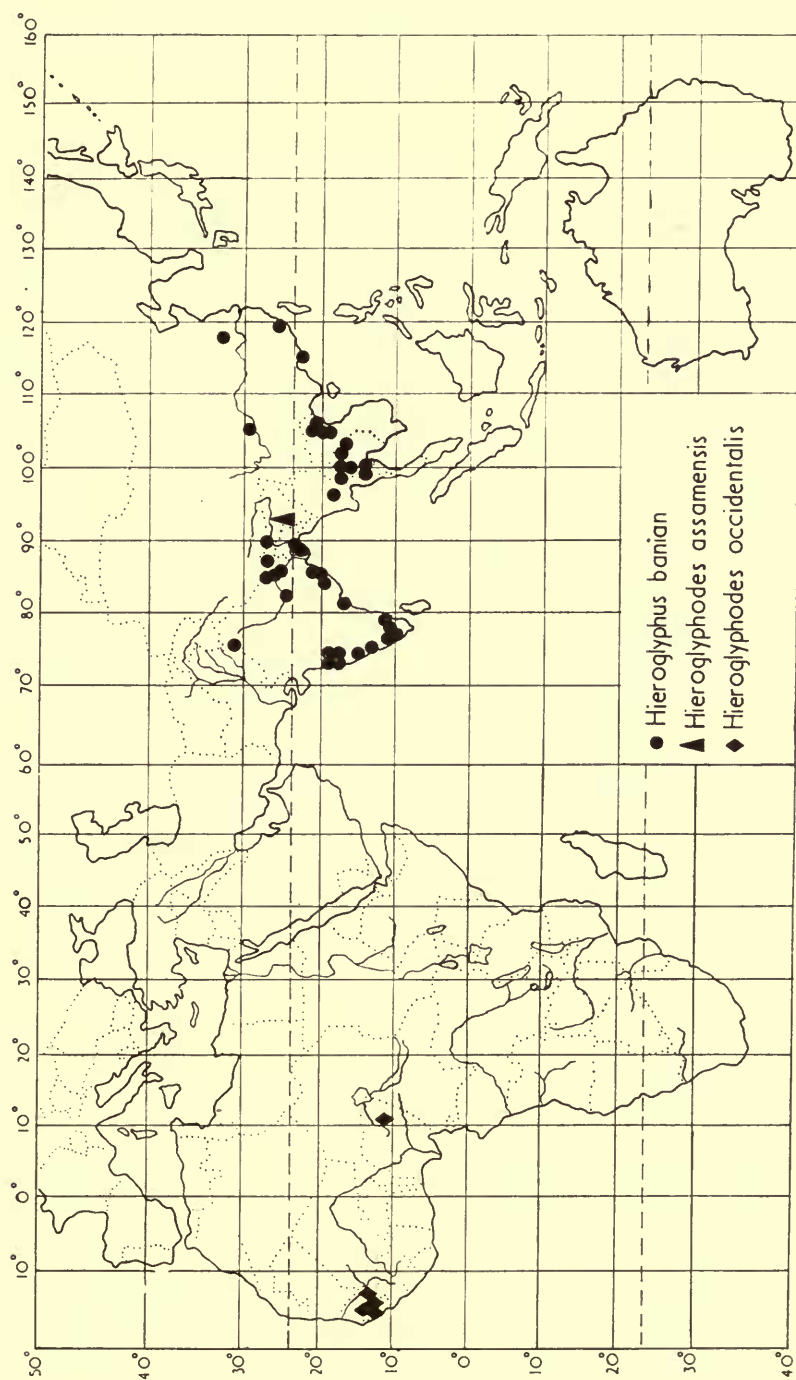
Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	31.3-38.9	6.0-7.5	22.6-32.2	16.7-20.5
Female	41.6-53.6	7.8-10.3	27.1-43.9	21.4-28.2

I have compared the original type-material of Fabricius with the description and diagnosis of *Acridium furcifer* and the holotype of *Hieroglyphus banian* var. *elongata*. All are conspecific. As Uvarov (1922) stated, *H. banian* var. *elongata* is only an extreme morphological variation which may be caused by ecological conditions, or genetic factors. There is considerable variation in the size of the body, the degree of slope of the face, and the width of the fastigium of the vertex anteriorly; the mesosternal interspace may be open or nearly closed. The tegmina and wings sometimes extend beyond the end of the abdomen and sometimes do not quite reach the end. Transitions were found in all the material studied. The general shape of the male bifurcate cercus and the phallic complex are constant.



FIGS 96-106. *Hieroglyphus banian* (F.). Male, 96, head and pronotum, from above; 97, end of abdomen, from above; 98, cercus, lateral view; 99, phallic complex, from above, with epiphallus and ectophallic membrane removed; 100, same, lateral view; 101, endophallus, lateral view; 102, epiphallus; 103, epiphallus, from different angle. Female, 104, subgenital plate, ventral view; 105, lower valves of ovipositor, ventral view; 106, spermatheca.



MAP. 4. Distribution of *Hieroglyphus banian*, *Hieroglyphodes assamensis* and *Hieroglyphodes occidentalis*.

From Fabricius' type-material of one male and two females that I have examined, a male lectotype has been designated, the others being paralectotypes. This type-material has one female from the Kiel collection labelled 'Ind or Daldorf Messrs S C T L' in Fabricius' writing.

MATERIAL EXAMINED

INDIA: 3 ♂, 2 ♀; Bombay, 1 ♂, 2 ♀; Belgaum, 12.xi.1905, 1 ♂; Khanapur, Belgaum-Dharwan Road, Malprabha River, 21.xi.1928, 1 ♂; Bengal, 18.xi.1906, 1 ♂; Cuttack, 23.xi.1905, 1 ♂; Ganjam District, Surada, 6 ♂, 4 ♀ (*G. Gabault*), 2 ♀; Maharashtra, Belapur Road, 29.v.1935, 1 ♀; Ahmadnagar Dt, Belapur, 10. vii.1938 (*Y. R. Rasen*), 2 ♂, 4 ♀ (*T. N. J. Laveni*), 1 ♂; Godaven, Samalkot, 20.ix.1907, 1 ♂; Khurda, 11.xi.1913, 1 ♀, paratype of *H. banian* var. *elongata* Uvarov; United Provinces, Shahganj, 4.xi.1904, 1 ♂, paratype of *H. banian* var. *elongata* Uvarov; Madras, Coimbatore, x. 1920 (*A. P. Nathan*), 3 ♂, 4 ♀; viii. 1921 (*A. P. Nathan*), 1 ♀; 6.xii.1910 (*E. Ballard*), 1 ♀; 16.xi.1914, 1 ♀, 15.x.1914, 1 ♂; Sikkim, 3 ♂; Bihar, Gaya, 22.viii.1944 (*J. W. H. Rehn*), 1 ♂; Pusa, 2.viii.1920 (*S. C. Sarkar*), 1 ♂, x. 1907, 1 ♀, vi. 1908, 1 ♂, 1 ♀, 30.viii.1916, 1 ♀, 1911, 2 ♀, 1910, 1 ♀; Mysore State, Bhadravati, 1908, 9.x.1938 (*P. S. Nathan*), 1 ♀; Poona Furm, 28.xi.1906, 1 ♂; Hoshiarpur, viii. 1936 (*U. Bahadur*), 1 ♂, 1 ♀; Trinchinopoly, 1 ♂, 1 ♀; Tranquebar, 1 ♂, 1 ♀; Monts de Kodican, 1 ♂, 1 ♀; Nedungadu, 21.x.1931 (*R. S. Nathan*), 4 ♂, 6 ♀, 3.ix.1936 (*P. S. Nathan*), 2 ♀. NEPAL: 2 ♀. AFGHANISTAN: 1952-1953 (*G. S. Cotterell*), 1 ♀. BANGLADESH: Brahmaputra River, Goalundo-Gauhati, vii. 1919 (*Fletcher*), 1 ♀; Faridore, 30.viii.1909, 2 ♀. BURMA: 5 ♂, 1 ♀. VIETNAM (NORTH): Reg. de Thanh Hoa, vi. viii (*H. Fruhstorfer*), 2 ♀, 1 ♂; Hoa-Binh, 1929 (*A. de Cooman*), 1 ♀, 1927 (*A. de Cooman*), 1 ♂; Hanoi, 1911 (*Adj. Monceau*), 1 ♀, 1911 (*C. Dupouy*), 1 ♂; Tuyen-Quang, 1914 (*L. Chopard*) 2 ♂. BHUTAN: 1900 (*R. Oberthur*), 4 ♂, 2 ♀. CHINA: Cochinchina, Bavi, v. 1935 (*S. Masseyeff*), 1 ♀; Szechwan, Bebe Bez, Ching Kong, 1929-31 (*Friedrich*), 1 ♀; Foochow, F. W. 1 ♀; Soochow, Kaing-Su 4.viii.1918 (*E. Suenson*), 1 ♂. KAIPONG I.: 2.ix.1963, 2 ♀. THAILAND: Bangken, 16.ix.1964 (*J. Roffey*), 1 ♀, Sukhothai, 10.vii.1961 (*P. Kaen Tasee*), 3 ♂, 8 ♀; Kanchanaburi, 20.vii.1966 (*P. Nawikbut*), 5 ♂; Sakon Nakhon, 3.viii.1956 (*C. Butarobul*), 3 ♀; Nong Khai, 29.viii.1964 (*P. Phelboon*), 1 ♂; Uttaradit, 28.ix.1961 (*J. Oonjai*), 2 ♀; Swan Province, Nakorn, vii. 1968 (*MacCuaig*), 12 ♂, 6 ♀, 1 nymph.

BIONOMICS. In Mysore State, India, the eggs are laid from October to December (Coleman & Kannan, 1911) and remain in the ground in the dry season until June or July. There is one generation a year. The laying is mainly in the grassy bunds round the paddy fields. In captivity about four egg-pods were laid per female and the number of eggs per pod was 29-49. In Assam each female lays 50-60 eggs altogether (Chowdhury & Majid, 1954). Butani (1961) and Janjua (1957) state that each pod contains 30-40 eggs, whilst Grist & Lever (1969) give the number per pod as 35. Gupta & Saxena (1963) give the number of eggs per pod in Uttar Pradesh as 68-90, the average being 81. Hatching takes place shortly after the first heavy rain, about the middle of June in India, and continues for about six weeks. It is completed in 30-40 days (Coleman & Kannan, 1911). For males

the total development period from hatching in captivity was 75–98 days, and for females 87–105 days. Janjua (1957) states that eggs are laid two inches below ground surface during September to October in Pakistan. In West Bengal (Banerjee, 1957) and in Mysore (Coleman & Kannan, 1911), they are laid from October to December.

In Thailand hatching occurs between March and June (Roffey, unpublished MS) and oviposition in August and September.

CHROMOSOMES. There are 23 acrocentric chromosomes (Dutt, 1955). There are two pairs of short chromosomes, and only one pair of long ones. Differential spiralization of chromosomes is found in some isolated nuclei at metaphase.

ECOLOGY. The following information is mainly from Roffey (unpublished MS). In Thailand, this is a common species on elevated areas lying between rice-growing plains or in surrounding forests. It is found abundantly on the grass *Imperata cylindrica* which becomes established when the original forest is felled for maize cultivation.

Imperata grass determines the distribution and abundance of *H. banian*, some stands being several hectares in extent. The egg pods are laid in grass stands which are undisturbed when nearby land is ploughed for cultivation; they are also laid in the land that is to be cultivated, but the ploughing destroys them. This species is abundant also in dense grassy vegetation surrounding sugar plantations, where the soil is undisturbed, but it does not occur in the irrigated rice-growing areas as they are flooded when the adults lay eggs. Coleman & Kannan (1911) report from Mysore, India, that *H. banian* lays eggs almost invariably in the bunds surrounding the rice fields, and Janjua (1957) states that in Pakistan the young hoppers first feed on grasses on the bunds of the paddy fields. Gupta & Saxena (1963) state that in Uttar Pradesh, India, the hoppers fed first on *Cynodon dactylon* (doob grass) and later entered the sugar cane fields. A list of food plants is given below. Some of these records are from the literature and some from labels on specimens.

Bambusa spp.

Brachiaria sp.

Citrus sp.

Cocos nucifera

Cynodon dactylon

Dendrocalamus strictus

Echinochloa sp.

Eupatorium odoratum

Glycine max

Gossypium herbaceum

Imperata cylindrica

Justicia betonica

Musa sp.

Oryza sativa

Panicum miliaceum

Pennisetum typhoideum

Phaseolus aconitifolius

P. mungo

Ricinus communis

Saccharum officinarum

S. spontaneum

Sesamum indicum

Setaria sp.

Sorghum vulgare

Vetiveria zizanioides

Zea mays

ECONOMIC IMPORTANCE. *H. banian* is a major pest of rice, though there is little information on the exact amount of damage done. The earliest reported damage to crops, according to Rao & Cherian (1940), was in Raipur and Central Provinces in 1886. In S. India the earliest record is 1890 from the Ganjan district. Bhatia & Mathur (1964) record that in 1960 4,085 acres of rice were attacked in Andhra Pradesh, and in 1961 1,300 acres of rice were affected in Madhya Pradesh and 1,000 acres of jowar in Mysore.

Alam (1961) states that it is an important pest of rice in Bangladesh. Chowdhury & Majid (1954) report damage to rice in Assam, where the leaves and the soft grains are eaten. Coleman & Kannan (1911) record that the leaves of rice are eaten and the stalks cut through so that the ears fall. Estimates of crop-loss due to this insect on rice have varied from 25 to 95% in different parts of India (Anon. 1951a,b; Sengupta & Benhura, 1957). Further information on *H. banian* as a pest of rice is to be found in *Pans Manual* no. 3 (PANS, 1970). Other crops that suffer appreciable damage include sugar-cane and maize (see e.g. Roffey, 1964, 1965). Further information is given by Ramachandran (1952), Gupta & Joshi (1956), Main (1912), Janjua (1957), Roonwal & Balwant Singh (1958), Fletcher (1920), and Butani (1961).

PREDATORS AND PARASITES

Fungi:

Empusa (Entomophthora) grylli (Rao & Cherian, 1940)

Nematodes:

Probably *Gordius* sp. (Coleman & Kannan, 1911)

Mermis nigrescens Duj. (Rao & Cherian, 1940)

Mites:

Reddish mites found by Coleman & Kannan and Rao & Cherian.

Insects:

Mylabris sp. or a closely related genus (Coleman & Kannan, 1911)

Scelio hieroglyphi (Basaranra, 1953)

Frogs (Coleman & Kannan, 1911):

Rana leptodactyla Boulanger

Rana sp.

Lizards (Coleman & Kannan, 1911):

Mabuia beddomi Boulanger

Sitan ponticeriana Curv.

Snake:

Tropidonotus piscator (Coleman & Kannan, 1911)

Birds (Rao & Cherian, 1940):

Coracias indica (Indian Roller)

Haliastur indus Budd. (Brahmini Kite)

Milvus gavinda Sykes (Pariah Kite)
Corvus splendens Vieill (Crow)
C. macrorhynchus Waglar (Crow)
Dicrurus macrocerus Vieill (King Crow)
Acridotheres tristis (Mynah)

Mammals (Rao & Cherian, 1940):

Excreta, probably from jackals, was composed mainly of adult *Hieroglyphus* (mainly *H. oryzivorus*, but probably including *H. banian*).

PARAHIEROGLYPHUS Carl, 1916

Hieroceryx I. Bolívar, 1912 : 59. Type-species, by PRESENT DESIGNATION, *Hieroceryx bilineatus* I. Bolívar, 1912. [Homonym of *Hieroceryx* Tosquinet, 1896 (Hymenoptera).]

Parahieroglyphus Carl, 1916 : 482. Type-species, by monotypy, *Parahieroglyphus bilineatus* Carl, 1916 [= *Parahieroglyphus bilineatus* (Bolívar)].

Hierocericina I. Bolívar, 1923 : 76. [Replacement name for *Hieroceryx* I. Bolívar.]

Medium size. Moderately slender. Integument finely pitted; hairs present on sternites and on hind tibia. (Antennae broken.) Fastigium of vertex with depression in front of transverse furrow, at least twice as broad as long, apex obtuse-angular. Weak carinula of vertex present. Frontal ridge with shallow sulcus and parallel edges. Frons in profile inclined backwards, straight or convex. Dorsum of pronotum flattened; median carina weak linear, crossed by three narrow, shallow sulci; lateral carinae absent; metazona half as long as prozona, its posterior margin obtuse-angular. Prosternal process conical. Tegmina and wings shortened, when folded their apices reaching third abdominal segment. Radial area of tegmen with several regular thickened, transverse, stridulatory veinlets, well developed. Tubercles present in the precostal, costal and sub-costal area (the purpose of these tubercles is unknown). Hind femur moderately slender. External apical spine of hind tibia present. Arolium moderately large. Supra-anal plate acute-angular, slightly broader than long, apex subacute. Subgenital plate small, obtusely conical, as long as broad. Male cercus very large, apex divided into three lobes; upper and middle lobes much larger than lower.

Phallic complex. Apical and basal valves of penis divided. Valves of cingulum larger than apical valves of penis, expanding in front of small narrow curved apex. Ectophallic membrane forming ventral sclerotization. Epiphallus divided, thick, robust, broader in apical part than in basal part, with moderately large ancorae, lophi curved inwards and upwards.

Ovipositor moderately robust, apices of lower valves obtuse. Subgenital plate trilobate. Spermatheca with long apical and shorter preapical diverticulum (only *P. bilineatus* female abdomen was seen by the author).

Parahieroglyphus differs from *Hieroglyphus* and *Hieroglyphodes* in that the eyes are less prominent: the pronotum is more flattened dorsally and less cylindrical: and the transverse sulci of the pronotum are narrower and weaker. The male cerci are very large, stout, thick and divided into three lobes. The male supra-anal plate is small and triangular, with three or five shallow callosities.

KEY TO THE SPECIES

- 1 (2) Frons in profile straight (Text-fig. 108). Male cerci with upper lobe as long as middle lobe (Text-fig. 110). Epiphallus broader apically (Text-fig. 115) ***bilineatus*** (Bolívar) (p. 548)
- Frons in profile convex (Text-fig. 119). Male cerci with upper lobe much shorter than middle lobe (Text-fig. 121). Epiphallus much broader apically (Text-fig. 125) ***colemani*** (Bolívar) (p. 550).

DESCRIPTIONS OF THE SPECIES

Parahieroglyphus bilineatus (I. Bolívar, 1912)

(Text-figs 3, 107-118, Map 3)

Hieroceryx bilineatus I. Bolívar, 1912 : 60. LECTOTYPE ♂, INDIA (IEE, Madrid), here designated from 1 ♂, 1 ♀ syntypes [examined].

Hieroglyphus bilineatus Kirby, 1914 : 202. Syntypes of both sexes, 'BENGAL' (lost). [Synonymized by Uvarov, 1922 : 227.]

Parahieroglyphus bilineatus Carl, 1916 : 483. LECTOTYPE ♂, INDIA (MHN, Geneva), here designated from 13 ♂, 12 ♀ syntypes [examined]. [Synonymized by Uvarov, 1922 : 227.]

♂. Medium size. Integument finely pitted. Frons in profile straight, inclined backwards. Cerci very large, divided into three lobes, upper lobe subacute, same length as middle lobe which is greatly expanded at apex, lower lobe small, narrow-elongate, curved upwards.

Phallic complex. Comparatively broad. Apical valves of penis broader than valves of cingulum, apices obtuse, valves of cingulum slightly expanded at apical part, with incurved apices; basal valves of penis robust, expanding at ends; dorsal ridge of valves smooth; gonopore process expanding at base, narrowing at apex; zygoma of cingulum narrow; rami broad; apodemes diverging forming U-shaped structure, approximately same length as basal valves of penis, gradually narrowing to obtuse apices. Epiphallus robust, slightly broader in apical part than in basal part, lophi thick, robust, moderately short and upcurved, facing towards centre of bridge; ancorae thick, of moderate length.

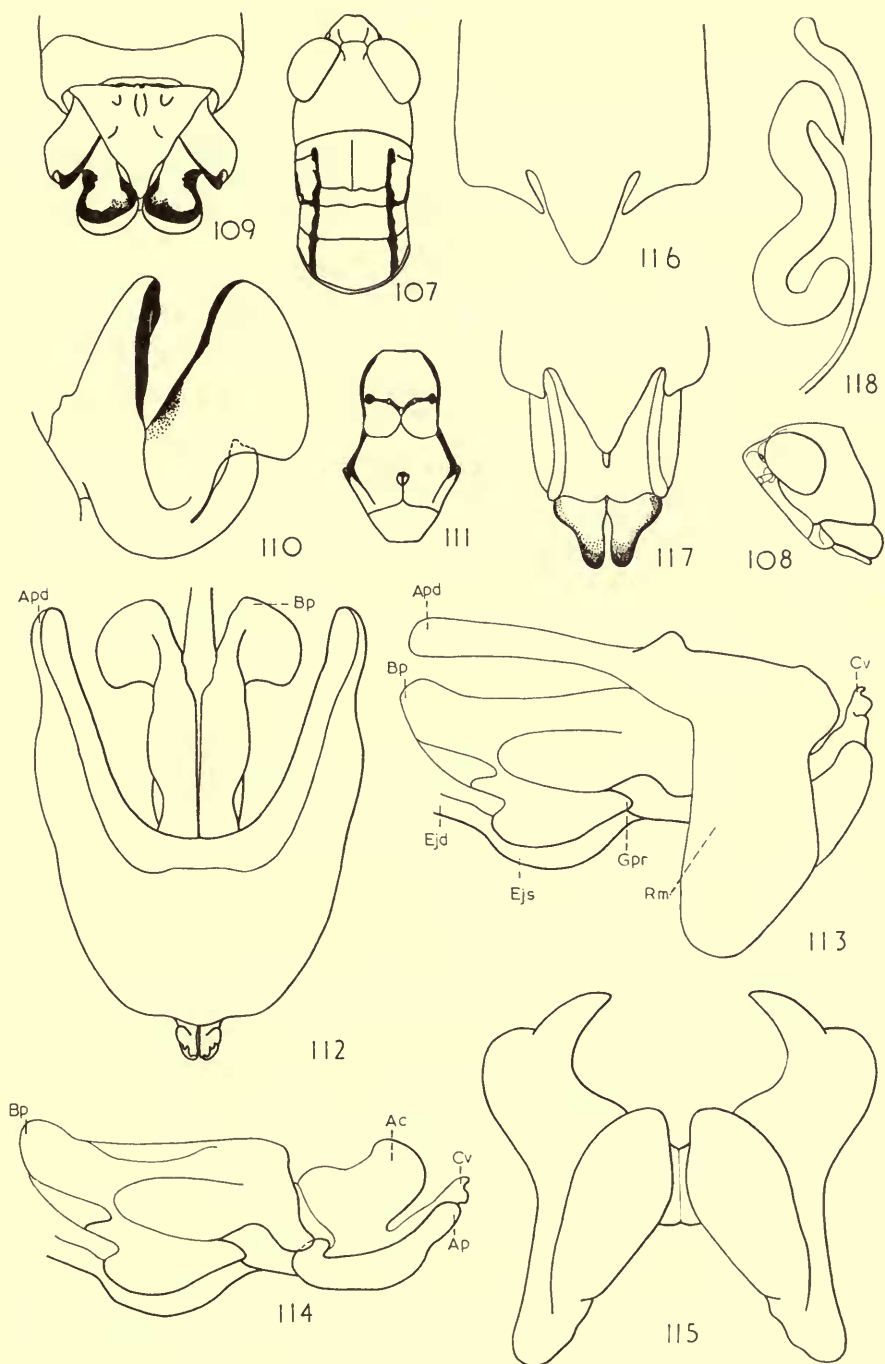
General coloration buff, with dark brown or black markings. Pronotum with two narrow black longitudinal stripes in prozona and metazona; third sulcus black on sides, with band forming an L-shape pointing towards head. Tegmina with longitudinal black stripe continuing from pronotum along post-cubital vein. Edge of last abdominal tergite black at centre. Knee with black patches on both sides. Hind tibia bluish grey, base black; tips of spines black. Edges of upper and middle lobe of cercus black.

♀. Larger than male. Fastigium of vertex three times as broad as long. Subgenital plate trilobate with lateral lobes shorter and narrower than central lobe.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	19.1-25.2	5.1-5.4	8.5-8.7	11.5-12.5
Female	33.6-38.3	7.2-8.5	8.8-11.1	17.7-19.2

This species was given the name *Hieroglyphus bilineatus* (see Kirby, 1914, p. 202) by Saussure in a manuscript and specimens were sent to different museums with the result that it was described three times, by Bolívar, Kirby and Carl, under different generic names but the same specific name. From the structure of the internal genitalia and other external generic characters it is obvious that it does not belong to the genus *Hieroglyphus*. It is therefore retained in the genus *Parahieroglyphus* Carl. A good series of syntypes from the Muséum d'Histoire Naturelle, Geneva, has enabled me to give the variation of characters within the species. The length of the tegmina of the males varies considerably; sometimes they even extend to the last abdominal tergite. The frontal ridge sometimes diverges just below the ocellus. The length of the upper lobe of the male cercus may be slightly shorter than the middle lobe. The mesosternal interspace of the females is sometimes slightly open.



FIGS 107–118. *Parahieroglyphus bilineatus* (I. Bolívar). Male, 107, head and pronotum, from above, 108, head, lateral view; 109, end of abdomen, from above; 110, cercus, lateral view; 111, meso- and metasternum; 112, phallic complex, from above, with epiphallus and ectophallic membrane removed; 113, same, lateral view; 114, endophallus, lateral view, 115, epiphallus. Female, 116, subgenital plate, ventral view; 117, lower valves of ovipositor, ventral view; 118, spermatheca.

MATERIAL EXAMINED

INDIA: Bombay, Ghat Kopar, 17.vii.1910 (S. H. Prater); Chikalda, Berars, 3664' (N. B. Kinnear), 1 ♀; Simla Hills 5-7000', 1926 (A. Jones) 1 ♀; 'Indies Orient' (Saussure), 10 ♂, 8 ♀, 1 nymph (paralectotypes of *P. bilineatus* Carl, 1916); (Saussure) 2 ♂, 1 ♀; 'Himalaya' (Hy. de Saussure) 3 ♀, (paralectotypes of *P. bilineatus* Carl, 1916).

BIONOMICS. According to Katiyar (1956) eggs are laid in Dehra Dun, India in September and October. Each female lays 3-5 egg-pods, averaging 31 eggs per pod. Hatching occurs from the end of May to the beginning of July. There are six moults in both sexes, but the males become adult 10-16 days earlier than the females.

ECOLOGY. The egg-pods are inserted at a depth of 2.5-6.4 cm in sandy loam along the sides of trodden paths in the bamboo area, close to the margins of the paddy fields, and along cart tracks in the Bibiwala forest. This species is common near high grasslands in the forest around Dehra Dun. It feeds on grasses including rice, and maize.

PREDATORS. *P. bilineatus* is attacked by the birds *Eudynamis scolopaceus* L. and *Coracias benghalensis* L.

***Parahieroglyphus colemani* (I. Bolívar, 1912)**

(Text-figs 119-125, Map 3)

Hieroceryx colemani Bolívar, 1912 : 61. Holotype ♀. INDIA; Mysore, Anavatti (IEE, Madrid [examined]).

♂. Medium size. Integument finely pitted. Frons in profile, inclined backwards. Cerci divided into three lobes with the upper lobe truncate at apex, much shorter than middle lobe, middle lobe narrow at base, expanded at rounded apex, lower lobe small, narrow, elongate-round at apex. Femur absent.

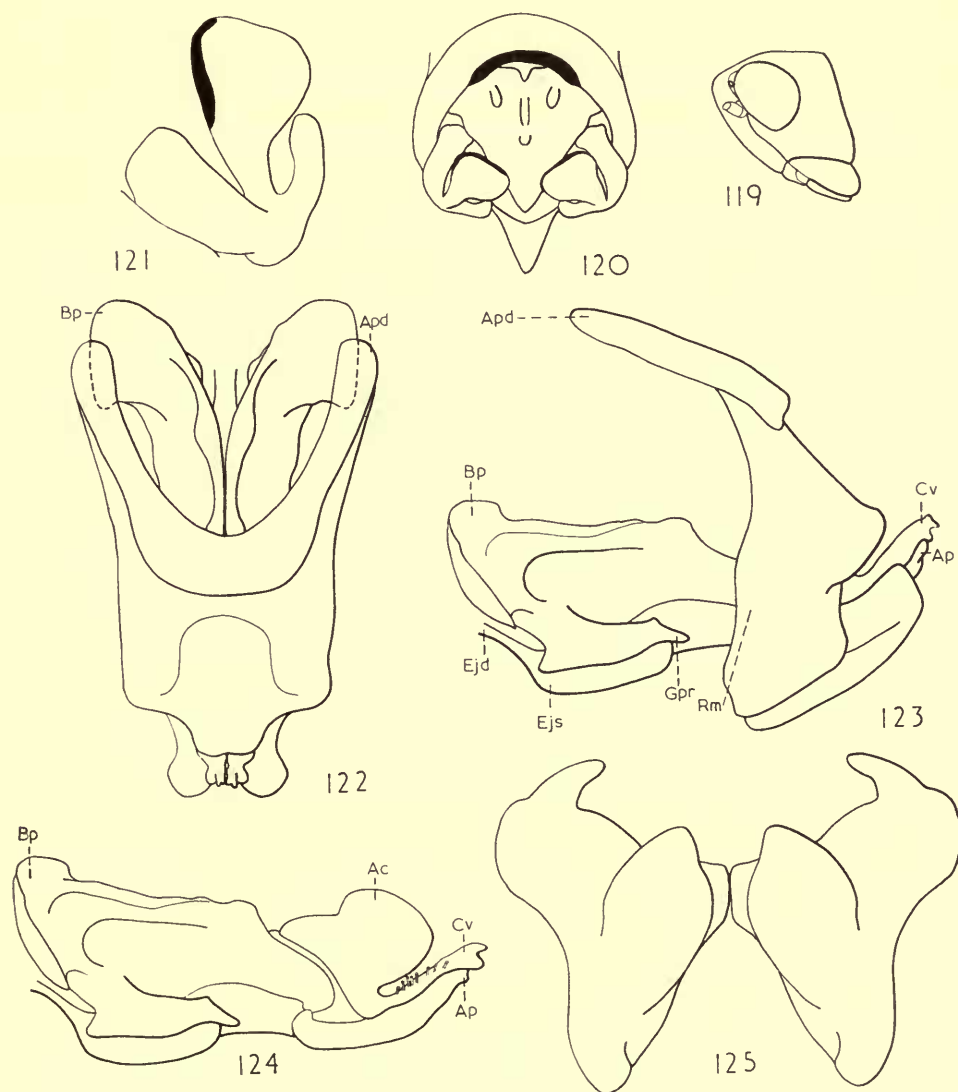
Phallic complex. Comparatively narrow. Apical valves of penis approximately the same width as valves of cingulum, with obtuse apices; valves of cingulum slightly longer than apical valves of penis, expanded at apices which are incised; basal valves of penis robust, expanded at ends; dorsal ridge of valves relatively smooth; gonopore process expanded at base, narrowing towards apex; zygoma of cingulum moderately broad; rami broad with upcurved projection covering part of apical valves of penis, projection of rami dorsally expanded; apodemes diverging, relatively narrow, slightly shorter than basal valves of penis. Epiphallus much broader than basal part.

General coloration buff (in dry specimens). Pronotum with pair of narrow black longitudinal stripes in prozona and metazona. Tegmen with black longitudinal stripe from pronotum along post-cubital vein. Edge of last abdominal tergite brownish black at centre. Callosities on supra-anal plate reddish brown. (Femur and tibia absent.) Edge of upper and particularly middle lobe of cerci black.

♀ damaged.

Measurements of male. Length of body 21.4 mm; tegmen 7.6 mm. The pronotum was damaged and the hind femora are missing.

This species was described originally from a single female, of which now only the head and pronotum remain. Only one male was studied; this specimen, which is described above, is the one that Uvarov (1922) mentioned. I too am assuming that this specimen is *P. colemani* because it agrees with the characters mentioned by Bolívar. The structure of the internal genitalia and certain external characters



FIGS 119-125. *Parahieroglyphus colemani* (I. Bolívar). Male, 119, head, lateral view; 120, end of abdomen, from above; 121, cercus, lateral view; 122, phallic complex, from above, with epiphallus and ectophallic membrane removed; 123, same, lateral view; 124, endophallus, lateral view; 125, epiphallus.

confirm that this specimen is not *P. bilineatus*. No undamaged female is available for examination, and until other specimens of both sexes are available the correct naming of this species remains in doubt.

MATERIAL EXAMINED

INDIA: Surat, Bombay, x. 1903, 1 ♂.

HIEROGLYPHODES Uvarov, 1922

Hieroglyphodes Uvarov, 1922 : 228. Type-species, by original designation, *Hieroglyphodes assamensis* Uvarov, 1922.

Medium size. Moderately slender. Integument finely pitted. Hairs present on ventral surface of abdomen and on hind tibia. Antenna longer than head and pronotum together. Eyes large, prominent. Fastigium of vertex with depression one-and-a-half to two times as broad as long in front of bow-shaped transverse furrow; apex obtuse-angular. Weak occipital carinula present. Frontal ridge sulcate throughout, with margins divergent downwards. Frontal ridge forming an acute angle, rounded at apex, with fastigium of vertex. Pronotum cylindrical or slightly narrowing in metazona; median carina weak, linear, crossed by three wavy, deep, broad sulci; metazona longer than half length of prozona, its posterior margin obtuse-angular. Prosternal process conical at apex, pointed. Mesosternal interspace narrowing at centre, open; metasternal interspace closed. Tegmina and wings just passing second abdominal tergite, apex narrow or very narrow, downcurved. Radial area of tegmen with several regular thickened, transverse, stridulatory veinlets, poorly developed. Tubercles present in the precostal, costal and subcostal area (the purpose of these tubercles is unknown). Tympanum well developed, average size, with small dorsal shell covering, no subtympal lobe. External apical spine of hind tibia present. Arolium as large as or slightly larger than claw. Supra-anal plate broader than long, trilobate with small middle lobe, apex elongate, subacute central deep sulcus with two ridges interrupted at centre, median lateral convexities present. Subgenital plate moderately short, at apex truncate or obtuse. Cerci large, broad, upcurved with wide incurved apex, curving over supra-anal plate.

Phallic complex. Apical and basal valves of penis divided. Apical valves of penis narrower than valves of cingulum, narrowing at apices; valves of cingulum longer than valves of penis. Ectophallic membrane forming ventral sclerotization. Basal valves of penis moderately slender. Epiphallus divided, small, with long or relatively long ancorae and moderately small two-lobed lophi.

General coloration dirty brown, buff or greenish brown with dark brown and black patches, shiny. The four sulci on pronotum with broad black bands, the first, second and third bands interrupted at centre. Lateral lobes of pronotum with black band running horizontally from third sulcus towards first. Knee with black patches on both sides, base and apex of hind tibia black; tips of spines black.

♀. Larger than male. Subgenital plate trilobate, with lateral lobes slightly longer than middle lobe. Ovipositor moderately robust.

This genus was originally described by Uvarov in 1922 from one male and one female from Assam; this is the only material of the type-species available for study. A second species was described by Roy on the basis of a unique male specimen from West Africa. The male genitalia had not been studied previously in either species; investigation of them has shown marked differences between the species but has confirmed that they are congeneric.

KEY TO THE SPECIES

- 1 Head broader than pronotum. Pronotum narrower in metazona than prozona (Text-fig. 126). Cercus relatively narrow at base, expanding at apex, which is directed forwards (Text-fig. 128). *assamensis* Uvarov (p. 553)
- Head of same width as pronotum. Pronotum cylindrical, of same width in metazona and prozona (Text-fig. 136). Cercus relatively broad at base, expanding at apex which is directed backwards (Text-fig. 138) *occidentalis* Roy (p. 555)

DESCRIPTIONS OF THE SPECIES

Hieroglyphodes assamensis Uvarov, 1922

(Text-figs 126–135, Map 4)

Hieroglyphodes assamensis Uvarov, 1922 : 228. Holotype ♂, INDIA: Assam, Cachar (BMNH) [examined].

Holotype ♂. Medium size. Integument finely pitted. Head slightly broader than pronotum. Fastigium of vertex twice as broad as long. Weak occipital carinula present. Frontal ridge slightly widening downwards. Pronotum narrowing in metazona. Tegmen lancet-shaped, narrowing at apex. (Hind femur broken.) Arolium (in female) as large as claw. Supra-anal plate considerably broader than long. Cercus broad at base, upcurved, narrowing, but broadly expanding at apex, which is directed forwards, apex rounded. Subgenital plate with obtuse apex.

Phallic complex. Valves of cingulum moderately broad, with obtuse apices and a row of hair-like stubs; basal valves of penis moderately robust, dorsal ridge relatively smooth; gonopore process large, elongate, narrowing at apex; zygoma of cingulum with elongate central projection with obtuse rounded apex; rami broad with narrow extension at the base which upcurves; apodemes diverging forming a V-shape, slightly shorter than basal valves of penis, gradually narrowing to an obtuse apex. Epiphallus slightly broader in apical than basal part, lophi short, with rounded lobes facing towards middle, ancorae moderately long.

General coloration dirty brown (probably discoloured and more or less greenish in life) with yellowish brown and dark brown patches.

♀ (paratype). Differs from male in fastigium of vertex being three times as broad as long; mesosternal interspace wider than in male, half as broad as long; middle lobe of subgenital plate shorter than lateral lobes, apex of middle lobe with three small projections. Hind tibia yellowish brown.

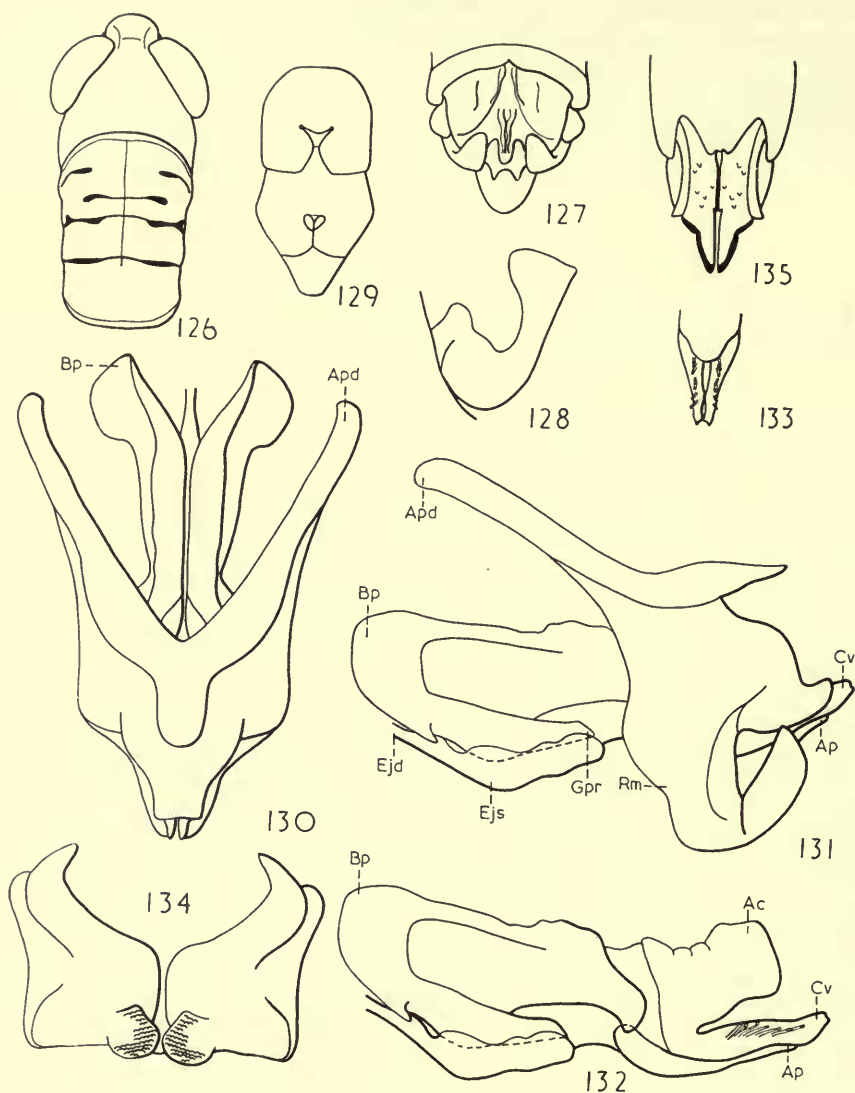
Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	28.0	6.2	8.5	(absent)
Female	40.5	8.3	10.9	18.7

Only two specimens of this species are known, the male holotype and the female paratype. It differs from *H. occidentalis* in the characters given in the key.

MATERIAL EXAMINED

Known only from the male holotype and a female paratype with the same data.



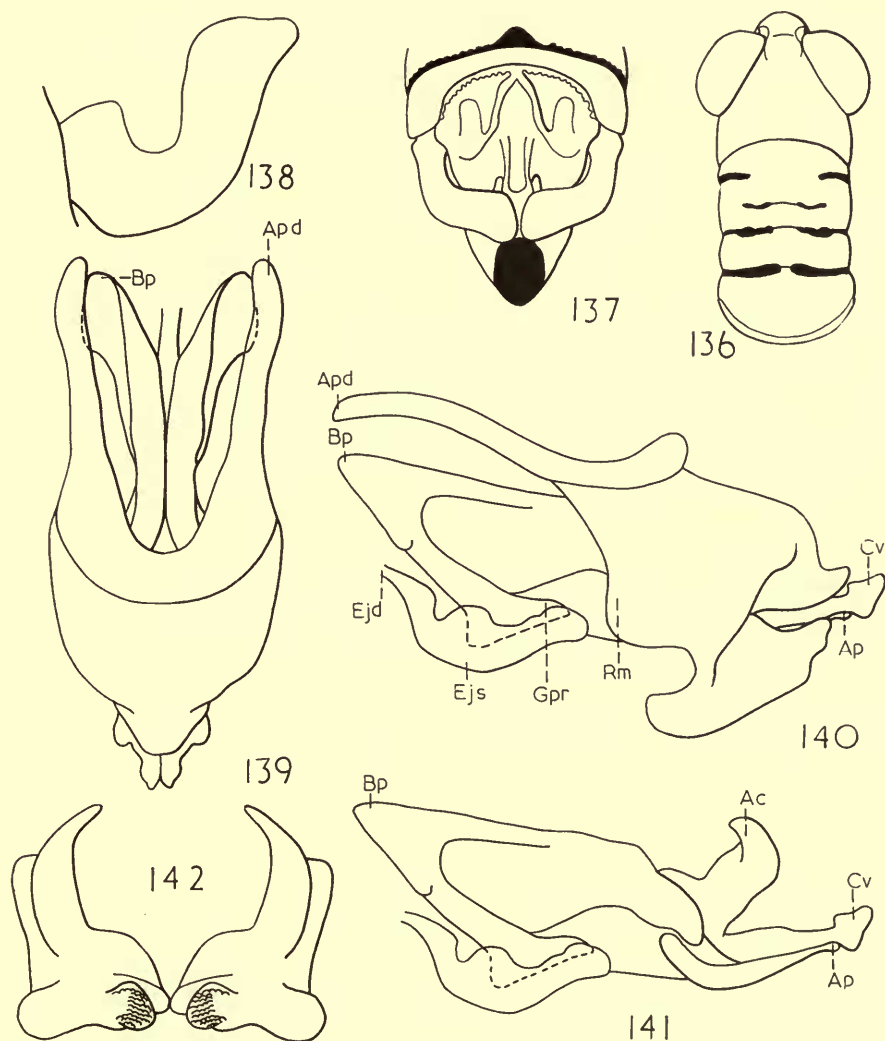
FIGS 126-135. *Hieroglyphodes assamensis* Uvarov. Male holotype, 126, head and pronotum, from above; 127, end of abdomen, from above; 128, cercus, lateral view; 129, meso- and metasternum; 130, phallic complex, from above, with epiphallus and ectophallic membrane removed; 131, same, lateral view; 132, endophallus, lateral view; 133, valves of cingulum, from above; 134, epiphallus. Female paratype, 135, subgenital plate and lower valves of ovipositor, ventral view.

***Hieroglyphodes occidentalis* Roy, 1961**

(Text-figs 2, 136-142, Map 4)

Hieroglyphodes occidentalis Roy, 1961 : 123. Holotype ♂, SENEGAL: Niokolo-Koba, between Badi and Bafoulabé, savanna, 23.xi.1959 (MNHN, Paris) [examined].

♂. Small to medium size. Integument finely pitted. Head as wide as pronotum. Fastigium of vertex one-and-a-half times as broad as long. Frontal ridge twice as wide at base as at apical part. Pronotum cylindrical. Tegmen at apex very narrow. Arolium



FIGS 136-142. *Hieroglyphodes occidentalis* Roy. Male, 136, head and pronotum, from above; 137, end of abdomen, from above; 138, cercus, lateral view; 139, phallic complex, from above, with epiphallus and ectophallic membrane removed; 140, same, lateral view; 141, endophallus, lateral view; 142, epiphallus.

slightly larger than claw. Supra-anal plate slightly broader than long. Subgenital plate with truncate apex. Cercus very broad throughout, becoming broader at apical end, directed backwards, at apex obtuse.

Phallic complex. Valves of cingulum moderately broad, expanding just before apices, apices narrowly rounded; basal valves of penis moderately slender, dorsal ridge smooth; gonopore process narrow, expanding at apex; zygoma of cingulum with no central protrusion, rami very broad with upcurved extension; apodemes narrow, slightly longer than basal valves of penis, U-shaped, narrowing to rounded apex. Epiphallus slightly broader in apical than basal part; ancorae long; lophi short with rounded lobes facing inwards.

General coloration buff or yellowish green. Ninth abdominal tergite with black band on its posterior margin. Tip of subgenital plate black. Hind tibia bluish grey.

♀. As the male, but larger. Differs in the fastigium of vertex being two-and-a-half times as broad as long; lower valves of ovipositor elongate with subacute apices and two external lateral projections, the apical one rounded, the basal pointed.

Measurements (mm).

	Length of body	Length of pronotum	Length of tegmen	Length of hind femur
Male	23.0-25.0	5.2	7.0-7.6	13.2
Female	40.7	8.0	11.4	19.2

This species is similar to *H. assamensis* in the general shape of the upcurved male cercus, in the supra-anal plate being trilobate, with a small middle lobe, and in the divided epiphallus with the deeply sclerotized lobes of the lophi turning inwards, and in the elongate ancorae. It differs from it in the characters given in the key and in the phallic complex (Text-figs 139-142) (particularly the expanded apex of the valves of the cingulum, the absence of a protrusion on the zygoma and the very long ancorae of the epiphallus).

MATERIAL EXAMINED

SENEGAL: Ziguinchor, Rizieres, 28.viii-3.ix.1962 (*R. A. Farrow*), 2 ♂. GAMBIA: Tabi, Signona, 14.xi.1961, Basse-Casamanco, Lisiere Foret (*Mission IFAN*), 1 ♂. NIGERIA: Bajoga, 28.ix.1970 (*G. Popov*), 1 ♂, 1 ♀.

ECONOMIC IMPORTANCE. This species was found by Mr G. Popov causing considerable damage to cotton in Nigeria, Bajoga, 28.ix.1970.

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Synonyms or names that are not valid are written in *italics*. Page numbers in bold type refer to the descriptions.

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